

PURCHASING

PRINCIPLES AND PRACTICES

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BY

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DEDICATED TO
THE PURCHASING AGENT

THIS BOOK WAS WRITTEN IN THE HOPE THAT THE PURCHASING AGENT OF TODAY AND TOMORROW MAY FIND IT OF SERVICE IN HIS DAILY ATTEMPT TO MAKE THE DOLLARS HE SPENDS WORK HARDER AND MORE EFFICIENTLY.

CONTENTS

CHAPTER	PAGE
I. INTRODUCTION AND SOURCES OF INFORMATION	1
The need for study; Technique of other professions; Skeleton of requirements only; Some succeed without study; No advancement without labour; How library may serve the purchasing agent; Some examples; How to find the material needed; How to read; Types of authors.	
II. FACTORS IN PRICE CHANGES	9
Theory of prices; Supply and demand; An illustration; Buyer must consider all the facts; The pendulum swing of prices; Individual Items may be uneven; Buyers must not gamble; Business cycles; Law of substitution; Demand may be fictitious; Purchasing agent must be able to make an intelligent guess.	
III. A TYPICAL PURCHASING DEPARTMENT	15
The waggon-maker begins; He needs more funds; The first general office man; The overshipment and its sequel; The delayed shipment and the remedy; The system is improved; Stock records and perpetual inventory; The purchasing agent emerges; His opportunities and temptations; The automobile factory equipment; Special routine; Cash discounts; The system changes as requirements change; Some purchases do not follow the general rules; Illustration; The combine and the problems of the general purchasing agent; The system enthusiast; The grouch; The fussy buyer; The "good fellow"; The buyer who shirked detail; The buyer with family difficulties; The committee of experts.	
IV. QUALIFICATIONS FOR SUCCESS	33
Knowledge; Honesty; Self-control; A liking for people; Ability to keep his own council.	
V. THE ETHICS OF THE PROFESSION	37
Definitions; Some lag behind; Sales tactics; Department of justice acts; Liars will come to grief; Inside information; Confidential bids.	
VI. THE MECHANICS OF THE PROFESSION	41
The importance of routine often over-emphasized; Necessary routine is simple; Request to purchase; Quotation file; Purchase order; Order index; Accounts payable sheets; Two typical systems compared.	

CHAPTER	PAGE
VII. MODERN CATALOGUES AND FILES	63
Vertical file; Open shelves alphabetically; Open shelves numerically; According to size; A combination plan.	
VIII. RELATION TO OTHER DEPARTMENTS	66
Relation to production; Factory superintendent; Credit manager; Stores; Accounting; Sales force.	
IX. THE FUNCTION OF SPECIFICATIONS	74
Drafting specifications; Buying by specification; advantages and disadvantages; A practical test for paint.	
X. TESTING OF MATERIALS	78
Importance of tests; Specific cases; Inspection must be continuous; Tests in actual practice.	
XI. STORES EQUIPMENT AND FUNCTIONS	81
Distance from source of supply as a cost factor; Physical equipment; Shelving; Vertical bins for heavy parts; Stores records.	
XII. PURCHASE AND CARE OF OFFICE EQUIPMENT .	86
Purchase of pencils, pens, ink, carbon paper, etc.; Care and issue of these supplies; Desks and chairs; The purchase of stationery and printed forms.	
XIII. BUDGET CONTROL OF PURCHASES BY DETAILED ESTIMATES	94
The modern viewpoint; Income; Sales quotas; Production budgets; Purchase budgets; The flexible budget system; Typical examples; University budget system in detail; Bibliography.	
XIV. PROBLEMS IN PURCHASING LUMBER	111
Difficulties and pitfalls; Species of trees and variations due to environment of individual trees; Heart and sap wood; Railroad ties treated and untreated; Aids offered by lumber associations and Government bureaus; Bibliography.	
XV. PAPER	116
Importance of the industry; Equipment of the buyer; Constituents of paper; Manufacture; Kinds of paper; Reforms in trade customs; Mill brands vs. jobbers' brands; Selecting, ordering and inspecting paper; Testing of paper; Paper trade; Trade Customs; Bibliography.	
XVI. PAPER SUPPLIES USED IN CREAMERY INDUSTRY	139
Development of modern creamery methods; Better butter for less cost; Parchment paper printed and plain; Cartoons; Waxed and plain; Storage of wax paper; Hand wrapping and machine wrapping; Stitched vs sealed packages; Other supplies.	

CONTENTS

ix

CHAPTER	PAGE
XVII. PURCHASING AUTOMOBILE TIRES	145
Finding the best tire for your purpose; Rubber Fabric; Manufacturing processes; Cords vs. fabrics.	
XVIII. TEXTILE PURCHASING DIFFICULT	150
A simple test; The linen glass; Tensile strength; Special factors; Heat conductivity; No objection to shoddy; Costs; Buyer must know; Change sources only when necessary; Two ways to lose money.	
XIX. THE PURCHASE OF ADVERTISING	156
Peculiarities of the problem; Buying space; A typical advertising campaign; The plan; Educational work; Circularizing; Trade papers; Sales force; Coupons; Telephone canvass; Billboards.	
XX. PROBLEMS IN COPPER AND BRASS	165
Historical sketch; Producing regions; Electrolytic copper and lake copper; Slag; Impurities; Copper wire specifications; Sales methods; Sheets; Tubes; Alloys; Brass; Season cracking.	
XXI. PURCHASE OF MACHINERY AND MINE EQUIPMENT	174
Quality must come first; Rock drills; Nature of the work; Speed; Cost and upkeep; Weight of machine; Simplicity of operation; Opportunities for demonstrations; Hoisting engines; Careful study necessary; Gears; Drums; Ropes; Cages; Clutch; Brakes; Lathes; Pointers for the buyer.	
XXII. COAL FOR STEAM OR HEATING	183
First steps; Steam coals; Handling charges; Storage; Transportation; Juggling freight rates; The first choice; Carelessness and thefts; How a shortage was discovered; Long and short ton; Dry and as received analysis; Sampling; Moisture; Ash; Volatile; Fixed carbon sulphur; Heat value; Analysis interpreted; Smokeless coals; Coal grades and coal ranks; Bibliography.	
XXIII. COAL ANALYSIS A GUIDE ONLY	194
Guide only; Sampling; Some interesting charts and their explanation; Some analysis comparisons.	
XXIV. TECHNIQUE OF COAL STORING	200
Little data available; War compelled storage; Experience failed to teach; Prof. Stoek's conclusions; Power plant experience; Storing screenings.	

CHAPTER	PAGE
XXV. PROBLEMS IN STEEL BUYING	207
Chemistry; Common elements; Refractories fuel; Fluxes, basic and acid; Slag; Pig-iron; Pig-iron sales; Inexperienced buyers; Analysis of pig-iron; Impurities; Blast furnace; Bessemer furnace; Open hearth; Electric steel; Ingots and their defects; Scale-tears; Structural changes; Carbon; Steel hardening; Alloys; Bibliography.	
XXVI. MODERN FOUNDRY SUPPLIES	222
Moulding sand; Securing uniform quality; Coke; Fire brick; Malleable furnace practice.	
XXVII. CHICAGO ELEVATED: STORES DEPARTMENT .	225
Organization; Duties; Records; Stock order; Receiving memorandum; Monthly statements; Scrap materials; Travelling store-keeper; Forms.	
XXVIII. SALVAGE NOW A SCIENCE	243
Importance; Reclaimed goods; Scrap; Lumber reclamation; Contracts are desirable; Use car shipments; Records; Keep quality up; Classification of scrap; Non-ferrous scrap; Classification; Trim shop scrap; Miscellaneous scrap.	
XXIX. PROGRESS IN COÖPERATIVE BUYING	261
Progress with association of American colleges; Plan for coöperative buying; Central council of social agencies experiment.	
XXX. NOSTRUMS AND FANCY NAMES	272
High prices for wonder goods; Beware of fancy names; The lubrication expert; Disinfectants.	
XXXI. PRACTICAL PROBLEMS FOR SOLUTION . . .	276
Cinders; Paper towels; Tote boxes; The better price salesman; Carbon paper and gold pins; Cigars; Christmas gifts; The better price buyer; Waste paper; Paint tests; Coal contracts; Glycerine; Duplicate shipments; Envelopes; The steam pump; Scrap iron; Cotton yarn; Supply tests; Tires; Motor cars; Rubber stoppers; Coal shipments; The files; Quality right, billing wrong; Machinery; The paint salesman; Soap; Plumbing supplies; Defective castings.	
INDEX	293

CHAPTER I

INTRODUCTION AND SOURCES OF INFORMATION

The Need for Study.—There are still a few men whose opinions upon other subjects are worth considering, who apparently believe that anyone who is reasonably intelligent, can, without preparation, become a successful purchasing agent over night. I want to drive home the fact that it is just as impossible for a man without preparation so to spend money that he will best serve his firm, as it is successfully to follow any other trade or profession without preparation. It is equally impossible for the purchasing agent to continue to grow if he does not continue to study.

Technique of Other Professions.—The technique of any profession or occupation might, I suppose, be so boiled down that it could be stated in very few words. In the last analysis the whole technique of the lawyer is his knowledge of the basic principles of justice, as popularly administered, coupled with the ability to find and suitably present data concerning relevant cases which have been decided in the past. The whole technique of the surgeon might be summed up as the knowledge of the human machine, its ailments and the most modern remedies for those ailments, coupled with a more or less pleasing bedside manner. The whole technique of the chemist is capable of being condensed into the knowledge of the inherent qualities of the materials he works with, under varying conditions, and the actions and reactions that may, or may not, take place under certain conditions.

Just so, the whole technique of exchanging dollars for commodities might be summed up as the ability to find sources and materials that will secure for the purchasing agent's firm the greatest ultimate value; coupled with clean-cut integrity, and a knowledge of the laws governing the action and reaction of economic factors which regulate supply and demand,

2 PURCHASING PRINCIPLES AND PRACTICES

and so fix prices. If you will add the knowledge of how to find authoritative information concerning any problem and a genuine liking for people, you have the specifications for a successful purchasing agent.

This Is Skeleton Only.—What has been sketched above is, of course, only the skeleton of the requirements in each case. The lawyer must study his case books and learn methods of procedure. The physician must learn just how the human body is constructed, by painstakingly dissecting it in the laboratory. He must know his chemistry, pathology, and bacteriology, and he must serve as a hospital interne before he is capable of actually beginning his practice. He must continue to study as long as he lives, if he wishes to keep abreast of his profession. The lawyer must review and discuss with his fellow students hundreds of cases before he can be admitted to the bar. The engineer must spend many months in the laboratory, and in the field, before men will be willing to entrust to him the construction of a building or a bridge. The chemist must perform many routine experiments before his analysis may be considered authoritative.

From Apprentice to Student.—Just so, the purchasing agent who would make a worth while place for himself in his chosen line of work, must expect to serve a long and tedious apprenticeship. He should expect to remain a student all the days of his life, if he would secure the technical information and experience that will enable him to stand out from the crowd.

Some Succeed Without Continued Study.—It is true that there are thousands of physicians, and many lawyers, chemists and engineers, who manage to get along fairly well without doing much research work after they actually engage upon their life work. Some of them seem to get along rather well.

The physician may, however, ruin his whole career because he is not prepared to apply modern remedies for one of his most valued patients; the lawyer may lose his most important case because he is not familiar with the latest decisions; the chemist's analysis may be worthless; the engineer may find he has planned a building, but omitted important modern developments, if he has ceased to be a student. The purchasing agent who is not in touch with the great economic

forces which control supply and demand may find his firm suddenly embarrassed because he has not built up the business connections which will enable him to secure needed materials when the "pinch" comes; or he may find that he has tied up all available current resources in inventories, just when they need the goods least, and when they need ready money badly.

No Advancement Without Labour.—The object of this work is to describe briefly the purchasing profession as it is carried on in modern industry, to dwell in detail upon a few of the more important problems the buyer is apt to confront, to cite some typical business cases, to point out some of the most valuable sources of technical information, and to show how they may be profitably used.

The measure of success the individual attains in any line of work bears a very definite relation to the amount of time he spends in a serious study of the various complexities of his special problems.

Use the Libraries.—Every man who devotes his life to the advantageous spending of other people's money is constantly confronted by a series of problems involving the principles of economics and a very considerable amount of technical detail. In view of this fact, it is surprising that even the most successful purchasing agents use the libraries so little. Buyers lose many a night's sleep working out solutions for problems that confront them when they would find the solutions ready made if they were to spend a few hours in the library searching the material there available, instead of working it out for themselves.

How the Library May Serve the Purchasing Agent.—The fact that so many members of the purchasing profession are daily obtaining creditable results without recourse to the libraries speaks volumes for their ability, but does not say much for their conservation of energy. Few problems are new. Most of them are simply old friends in new clothes. As the great majority of all the discoveries of the world are recorded in books and current literature, the information you need may be found by searching the files.

Are your lubrication costs too high? You will find more technical information concerning lubrication in the average public library than you can absorb in many days. Read:

4 PURCHASING PRINCIPLES AND PRACTICES

BIBLIOGRAPHY OF LUBRICATION

1. ALLEN, IRVING C., "The Flash Point of Oils—Methods and Apparatus for its Determination." *U. S. Bureau of Mines Tech. Paper. No. 49.*
2. HERSCHEL, WINSLOW H., "Resistance of an Oil to Emulsification." *Bureau of Standards Technologic Paper, No. 86.*
3. "MEMORANDUM ON SOLID LUBRICANTS." Published for the Department of Scientific and Industrial Research by *His Majesty's Stationery Office—Great Britain.*
4. STILLMAN, THOMAS BLISS, "Examination of Lubricating Oils."
5. WATERS, CAMPBELL EASTER, "Carbonization of Lubricating Oils." *Bureau of Standards, Circular No. 99.*
6. WATERS, CAMPBELL EASTER, "Data on the Oxidation of Automobile Cylinder Oils." *Bureau of Standards Technologic Paper No. 73.*
7. WATERS, CAMPBELL EASTER, "The Evaporation Test for Mineral Lubricating and Transformer Oils." *Bureau of Standards Technologic Paper No. 13.*
8. WHEELER, GEORGE UZZIAH, "Friction and Its Reduction."

Surmises Instead of Facts Mean Loss.—Are you dissatisfied with the quality or the quantity of work turned out by the lumber kiln? Would you like to recommend that your firm install a kiln of their own? Read Harry Donald Tiermann's treatise on "The Kiln Drying of Lumber," or Joseph Berhard Wagner's "Seasoning of Wood," and ask the Director of the Bureau of Standards, at Washington, to send you all the technical papers he has on the subject.

You will then be in a position to back up your recommendations with authoritative information. One of the largest coal washeries in the country was erected because the company thought they could make it pay. It has operated at a loss from the first day. The trouble was that the man who backed the project depended on estimates and surmises instead of authoritative data. Nothing discredits a man more quickly than his unqualified endorsement of a project that later proves to be a losing venture.

Other Examples.—Do reports from the construction department show that some of the Portland cement work is not holding up? Ask the Director of the Bureau of Standards to send you a copy of his Annual Report for 1920. Turn to page 200, and note the remarkable changes detected in cement which had been stored only 28 days.

Are you having trouble with mimeograph paper. That is not a new problem. The Bureau of Standards has conducted a series of tests on this paper. Ask the Director to send you a copy of the report on these tests.

Are you buying for a manufacturing confectioner? Do you

know all the several dozen kinds of sugars? Do you know all about the "candy test for sugar"? You will find it on page 124 of the Director's report for 1920.

Do you want to compare your cost for having samples of materials tested with that of others? The 1919 report of the purchasing agent for the State of California contains some very interesting data on this subject.

Because the continued and consistent utilization of the technical data contained in the public and other libraries is of such vital importance to the purchasing agent who would excel, I shall explain briefly the method of working in a library at the risk of boring those familiar with such research.

How to Find the Data You Want.—All the books and most of the pamphlets contained in the library are listed in one large alphabetical file. For every book there are at least two cards, and there may be several cards for a book. One card is indexed under the surname of the author, and another under the subject, or the title of the book. If the book deals with several subjects, there will be a card for each subject. Each card bears a reference number by which the attendants may find the book in the stacks. Somewhere in each card drawer is a card of instructions, telling how the data you want may be located.

The card used by the University of Chicago Library reads as follows:

HOW TO USE THE CARD CATALOGUE

This is a catalogue of the books in the library alphabetically arranged by author, title and subjects like a dictionary or encyclopedia. For exceptions to this practice read the printed signs on the top of the catalogue cases.

Look for the book you want under the author, subject, or title, if a distinctive one.

The letters and numbers in the upper left hand corner of each card is the call number by which books may be drawn. In calling for books by this number, include location symbols, R R, Ed, etc. For key to these abbreviations, see sign on top of catalogue cases. All subject headings including names of persons treated as subjects are written in red ink. Consult the assistants at Information and Delivery desks for books and articles not found in the Catalogue.

How to Find Current Articles.—The card catalogue will enable you to find the material you seek if it has been issued in book form. If, however, you want to read the most recent data available, you must get it from current publications. There are bulky indexes which attempt to list all the worth while articles appearing in periodical publications. In them

6 PURCHASING PRINCIPLES AND PRACTICES

you will find the material arranged in the books much as the books are indexed in the card file. The best known indexes are "Poole's Index to Periodical Literature," which ceased publication in 1901, and the "Readers' Guide to Current Literature," which is kept up to date.

Other Sources of General Information.—In addition to material the purchasing agent may from time to time secure from the reference library as an aid to the solution of some special problem, he should have access at all times to a large number of current publications. He should read at least two trade papers dealing with each of the items for which he spends the most money.

If he buys many chemicals he ought to be a regular subscriber to "Drug & Chemical Markets," and one other trade paper. If he buys these drugs for resale, he ought to be familiar with the publications of the National Association of Retail Drugists. If he buys coal, he will need to read "Coal Age," or "Black Diamond," and the weekly reports published by the Bureau of Mines. If he spends a lot of money for iron and steel products, he will want to read the "Iron Age," the "American Metal Market," and one or two other publications. These trade papers will give him a good cross-sectional view of the details of conditions existing in their particular lines.

If he reads only trade papers he is a bit apt to become narrow, however. In order to fulfill to the fullest extent the functions of a purchasing agent, he should be familiar with the commodity reports issued by various statistical bureaus. He should read at least one commercial paper like the "New York Journal of Commerce," "Wall Street Journal," or the "Chicago Journal of Commerce." He should keep in touch with one or two general trade magazines like "Factory," "System," "One Hundred Per Cent," and "The Purchasing Agent."

Bank Letters.—In addition to the publications noted above, one of the most valuable sources of authoritative information upon the ebb and flow of industrial conditions is found in the publications of large banking institutions. These bank letters are free for the asking, and vary from a brief statement of local conditions as seen by the officers of the bank, to small magazines containing elaborate analyses of the changes which have taken place, and are taking place, in different trades in their particular territory. Among the most valuable bank

letters are those published by the Federal Reserve Banks of the various districts.

If you are to read these bank statements, it is, I believe, of prime importance that you get them not only from several banks, but that you get them from banks in several localities. You will find in comparing these statements, all of which are based upon supposedly careful analyses of conditions as seen by the officers of the bank, that they do not all agree upon some of the fundamental trends of the times. If you read only one or two you will not be in a position to form an unbiased opinion for yourself. If, on the other hand, you base your opinions concerning the probable trends of the markets in which you are interested, and concerning the whole flow of commodities and their prices, upon the opinions of the many, you will be able to direct the purchasing policy of your firm much more intelligently.

Back Your Decisions With Facts.—If the purchasing agent will absorb the information thus available, in addition to that provided by the daily papers, he will be in a position not only to make sound decisions, but will possess the authoritative and detailed facts with which to back up his decisions upon occasion. I am assuming here that every purchasing agent will have in his office at least two of the more reliable directories, in addition to a comprehensive catalogue file.

How to Read.—Many will no doubt feel that the amount of reading outlined here is so great that they would have little time for the administration of the office if they were to follow consistently the program mapped out. This is true, in part, at least. If you were to read every word in all the publications to which I have referred, you would have little time for anything else. In order to progress you must keep abreast of the times, and you must also turn out a large volume of work each day. You can do this only if you develop ability to extract the essentials of a book or magazine in the shortest possible time. To do this, you must learn to skim the pages, but so to skim them that you will miss nothing important.

Types of Authors.—In doing a large amount of reading you will soon discover that there are three classes of authors. First, there is the author who first makes a statement and then elaborates upon it. Second, there is the author who leads up to a conclusion which he states last; and third, there is the author who starts nowhere, wanders all over, and gets nowhere

8 PURCHASING PRINCIPLES AND PRACTICES

in particular. In the publications you read you will probably find very few of the third group, and in all probability most of the works will belong to the first. If, then, you will read the first few lines in each paragraph, or the first few paragraphs, you will be able to get all the information you want from a vast number of articles in a surprisingly short space of time. It is decidedly better to skim a large number of sources of information than to read in detail only a few. The ability to skim, and skim accurately, will develop as the volume and scope of your reading increase.

CHAPTER II

FACTORS IN PRICE CHANGES

Theory of Prices.—There is much difference of opinion among economists concerning the basic factors which determine price changes in the mass. Some believe that large price changes are determined by the relative mass of money and the relative mass of commodities. Some believe that the prices of commodities in the mass are not at all affected by the total amount of money, but are dictated by the total supply of commodities, and the total demand for these commodities.

In this discussion we are not concerned with these basic economic theories; we are, however, vitally concerned with commodity prices, their cause and effect.

Supply and Demand.—There can be no doubt that the price of any given commodity is determined at any one time by the two interacting factors, supply and demand. Because this is true, it is of prime importance to every purchasing agent to know the approximate supply of, and demand for, the commodities in which he is principally interested.

You should know not only the approximate supply and demand today, but you ought to know the producing capacity of the factories or mines turning out the product, and the approximate rate of consumption over a period of years. If the producing capacity is greater than the present, or potential, demand, you ought to know what steps, if any, are being taken to build up demand and consumption, and what steps, if any, are being taken to turn the excess producing capacity into other lines.

Prices of Steel.—For instance, the war demands for steel caused us to increase the total producing capacity of this country to approximately sixty million tons per annum. This is much more than the normal rate of consumption. If, then, you are a heavy buyer of iron and steel products, there is no reason to look for anything but a continuing decline in the price of these products. There is a huge producing capacity, and a rather limited demand. Under these conditions it would

10 PURCHASING PRINCIPLES AND PRACTICES

not be advisable to increase your stock or to make long-term commitments. Knowing as you do the present relation between the supply of, and the demand for, iron and steel products, you can accurately predict the trend of the price for this commodity.

If, however, there should be a great and sudden revival in business, there might be a temporary up-swing in the prices of iron and steel along with all other commodities. As it is hardly conceivable that there should be a revival of such magnitude that the demand for iron and steel products would be increased to nearly double our normal requirements, the increase in prices would, therefore, probably be only temporary. If, however, in the next few months a large percentage of the surplus producing capacity were turned over to other lines of production, and we should then have even a moderate revival in business, prices might advance somewhat, and might stay at the new level for some time. The amount of the price advance, and the period it lasted, would depend entirely upon the relation of supply and demand.

Buyer Must Consider All the Factors.—If you will take the time to study the actual and potential supply of, and demand for, the commodities in which you are principally interested, you will be very much better posted than are the majority of purchasing agents.

Your conclusions concerning probable price changes should, however, always be checked and weighed by the knowledge that these price changes are like nothing else so much as the swing of a pendulum. When the pendulum is swung violently in one direction it continues to swing in that direction until the force of gravity, plus friction and the inertia of the pendulum, are exactly offset. When the pendulum reaches that point in its swing, it is stationary for a minute fraction of a second, and then begins to swing in the opposite direction. The pendulum does not stop until it has swung almost as far in the other direction.

Humanity in the Mass.—In other words, any great swing in the mass behavior of human beings, whether it be in economics, religion or politics, always goes too far in both directions. A period of rigid enforcement of blue laws is always followed by a period of revolt in which the great mass of humanity goes too far in the opposite direction. A great swing in favor of free trade is always followed by a mass

sentiment in favor of protection. The violence of the back-swing depends largely upon the violence of the up-swing, although there are other factors which tend to modify action and reaction.

The Pendulum Swing.—There are two other points I wish to emphasize in this connection. First, there is a period when the swing of this pendulum has been nearly checked, and when there appears to be almost no movement in either direction. This period of rest is apparently greater when the swing has been less violent.

As any great swing in one direction is apt to be followed very quickly by a violent swing in the other direction, a period of inflation is followed by a period of deflation. A period of optimism is followed by a period of pessimism and depression, and the extent of both movements bears a very definite relation to the violence and extent of the previous movement.

It is always darkest just before dawn, and prices are always lowest before a great upward movement, and always highest before a great period of falling prices.

Individual Items May Be Uneven.—In reading these general principles and trying to apply them to your purchasing policies, bear in mind that they are true of prices in the mass and in the aggregate. The price cycle of any one commodity, however, may not follow the general swing because of some other modifying factor, or factors. In any period of price adjustment, whether it be adjustment upward or adjustment downward, there is always a certain degree of unevenness in the movements of specific commodities. If the general change in price levels is great and rapid, these uneven spots will be even more noticeable than if the movement is slow and of less extent.

Buyers Must Not Gamble on Commodity Market.—I have set forth briefly the economic background of price changes. In applying these rules to your specific business you must square the facts with other known facts which affect the particular commodities in which you are specially interested, and then map out your purchasing policy in the light of all the facts, and in accordance with the needs of your firm, and their financial ability to carry stocks; and in view of the high or low interest rates.

In the long run, it is never justifiable for the purchasing agent to gamble on the commodity market. He should buy

12 PURCHASING PRINCIPLES AND PRACTICES

material he knows he will need just far enough in advance to secure delivery when he needs that material, and no farther. We all know of men who have made a great deal of money for their firms by gambling on the commodity market with money which belonged to their firms, and the stockholders thereof. For every man who gambled and won, however, there is at least one man who gambled and lost. Your duty is to buy for consumption, or for resale, and not in order to pile up speculative profits.

The Earned Dollar Is Better.—There seems to be a certain sturdiness and worth about the dollar honestly earned that speculative profits do not possess. All too often the easy money is wasted, and many of the honest dollars that have been earned must be thrown after these dollars.

Business Cycles.—If you are interested in studying the details back of these business cycles, and would like to make the acquaintance of the men who stand behind the stage and shift the scenes, and would like to examine all the delicate machinery they work with, you will find great interest and profit in reading "Business Cycles," by Leslie J. Mitchell, of the University of California. This is one of the most valuable works of its kind in existence.

If you have not the time to read the whole book you should at least skim the last or third part. One of his interesting deductions is that the period that usually elapses between the peak in commodity prices and the point when they have reached bottom, and begin to move upward again, has always been from twenty-four to thirty-six months. Mr. Mitchell's conclusions are checked and backed up by a mass of tables and charts which are analyzed and summed up in a most scholarly manner.

Law of Substitution.—In endeavoring to foresee price changes that are likely to occur in any one commodity, two factors of great importance are often overlooked. The first is the law of substitution, and the second is the nice difference between demand and consumption, and producing capacity and visible supply.

For every commodity there is a peak price beyond which it cannot be forced. Up to that point the great majority of consumers will continue to pay the price, and will continue to buy nearly the same quantities they have been accustomed to consume. As the price of that particular commodity ap-

proaches the peak, however, more and more of the mass of people will cease to pay the price, and will either use a substitute, or will so arrange their plan of living that they will do without that particular item entirely. This applies to every commodity, regardless of its apparent necessity, and regardless of the apparent continued ability of the consuming public to pay the price asked.

The Peak Price in Sugar.—In the last great upward movement in the price of sugar, the buying and consuming public seemed to demonstrate pretty clearly that they would consume practically the same amount of sugar at twenty cents per pound that they did at five cents per pound. When the price approached thirty cents per pound, however, the consumption was noticeably curtailed, and this in spite of ability on the part of the great mass of consumers to pay the thirty-cent price.

Apartently the great mass of the American people regard thirty-cent sugar as too great a luxury. They do not think sugar can be worth that much money, and when the price approaches that figure, they cease to buy. This same law applies to every commodity; sugar is merely a striking illustration of the law.

Demand May Be Fictitious.—The experiences of the period of inflation which followed the ending of the World War showed conclusively that there was a very real difference between demand and rate of consumption, and between supply and rate of production.

Because of the breakdown in the transportation system, the railroads were not able to move materials of all kinds as fast as they were required. The average purchasing agent therefore ordered several times as much material as he actually needed to make sure that he would not run short. The result was that the demand for a carload of merchandise by the ultimate consumer might be multiplied to ten or fifteen cars by the time the order reached the producers through the many channels of trade, both regular and irregular.

This created a fictitious demand which had very little relation to the rate of consumption of the various commodities, and a short supply which would have been short for only a very brief period, was magnified many times, until it appeared that there was a permanent shortage in many lines.

In the long run, supply tends to equal demand, and in this case the actual supply finally caught up with the artificial

14 PURCHASING PRINCIPLES AND PRACTICES

demand, with the result that the whole market collapsed, and many purchasing agents of long experience were caught with stocks which had very little relation to the consumptive demands of their firms. In many cases this resulted in great financial loss and embarrassment.

Purchasing Agent Must Make Intelligent Guess.—In a word, the purchasing agent who is charged with responsibility for the purchase policies of his firm must be able to distinguish actual demand from an artificial demand. We all know what has happened after it has happened. The purchasing agent should be able, within reasonable limits, to foretell the thing that is apt to happen before it has happened.

The head of one of the greatest banking institutions in this country is credited with the statement that he had succeeded in piling up his immense fortune because he was able to tell what was going to happen in the commodities and securities markets six months before it did happen.

The average purchasing agent cannot hope to forecast the commodity markets six months in advance, but he should at least be equipped to tell what is going to happen when a new movement actually starts.

CHAPTER III

A TYPICAL PURCHASING DEPARTMENT

How a Purchasing Department Grows.—In the first two chapters we have pointed out the necessity for continued study, and have discussed at length some of the more important sources of information, and how they may be used. In the second chapter we discussed the theory of price changes, how these changes take place and how they affect the purchasing agent. Let us now look at the development of the modern purchasing department. Perhaps the best method is to examine the purchase-function in an infant industry, and then trace the development of the purchase-function as the business grows from a small shop into an integral part of a huge enterprise.

It is quite possible that much of the information brought out in the pages devoted to the development of a typical purchasing department will be familiar to experienced buyers, but even these men of wide experience may find the following outline interesting. Throughout this work we shall strive not only to cover the more technical phases of the purchase-function, but to discuss the more elementary details, so that the inexperienced may find them made clear, and the men of experience may not find them dull reading.

The father of the waggon maker was the village blacksmith, and the giant automobile industry is the step-child of the buggy and waggon maker. It has, therefore, seemed particularly fitting to trace the development of the purchase-function of the buggy maker as he develops.

The Business Is Founded.—In the early seventies Amos Johnson set up in the town of Crete a small buggy plant, and employed two helpers. In this plant, he occupied the position of sole owner and general manager, but he was also sales manager, production man, auditor, cashier, bookkeeper, purchasing agent, and storekeeper. His purchasing routine was simple. Whenever he wanted some more spoke dowels or leather for cushions, he wrote a longhand letter, or selected

the material in person. One evening each week he spent in making his simple day book, ledger and cash book entries, and in pasting the paid invoices in a huge scrapbook. The unpaid bills were stuck on a spindle back of the stove. Sometimes he discounted his bills, but more often he did not.

Amos built good buggies, however, and sold them at a right price, and it was not long before he found it necessary to add two more men to his working force. This meant that in order to keep up the quality of his product, and keep costs down, he had to spend more and more time in supervision, and less time in actual labour.

The First Bank Loan.—The business was growing nicely when he began to need more funds to bridge the gap between the purchase of the raw material and the collection of proceeds from the sale of the finished product. One afternoon he dropped in to talk the matter over with the local banker. He brought his last trial balance and a list of assets and liabilities, which interested the banker. He wanted to borrow \$2,000. There was a lot of extra fine oak lumber for sale at a bargain at the county seat, and he would like to borrow another thousand dollars to buy it. After going over all the facts, the local banker surprised him by offering to lend not \$3,000, but \$5,000. He specified, however, that the extra \$2,000 was to be used as a working fund. This loan was, moreover, to be made upon the one condition that he discount his bills, and that he employ a man to look after his office details, which were beginning to get away from him.

The First Office Worker.—The bargain was struck and John Smith, who had just been graduated from high school, was employed to handle the office end of the work. One of John's duties was to write out the longhand requests for materials, check up the deliveries, and to see that the bills were paid in time to earn cash discount. All went along smoothly until a dispute arose with a leather supply house, which had shipped ten dozen enameled horsehides when John had intended to order only one dozen.

The First Purchase Order Book.—The dispute was finally settled by the supply house allowing Amos six months in which to pay for the hides, but even then this bill ate an unpleasantly large hole in his cash reserves. The net result of this episode was the substitution of a pocket duplicate order book, using a pencil and one carbon copy, in place of a letter for ordering

materials. These orders were now made out by John, signed by Amos, and a carbon copy was always on hand to aid in checking bills, deliveries, and payments.

The First Shortage.—After the establishment of the new duplicate order system, things ran smoothly for a time, but occasionally a slow shipment, or the failure of the shop foreman to foresee his wants, caused Smith to move fast in order to keep the factory supplied with the necessary materials. The next difficulty arose when he took a week off to get married.

Now the Johnson buggies were noted for their fine glossy finish, which was due to the addition of a small quantity of China wood oil to the varnish coats. This was purchased from a broker in Chicago, one barrel at a time. The night after John left on his honeymoon, the foreman in the paint shop forgot to close the spigot on the barrel of China wood oil, and the remaining twenty gallons, which should have lasted three weeks, were all on the floor when he reached the shop next morning. Amos had taken a great deal of pride in the fact that his buggies were always ready to deliver when he promised them, but he took even a greater pride in the unvarying high quality of his product. Because of the leaky spigot and the lost China wood oil, a shipment of Johnson buggies was late for the first time since the business was founded.

The Remedy.—The net result of this accident was a rule that the China wood oil must be carried in one gallon cans instead of in a barrel, and twenty cans were put in a special cupboard as a reserve supply to guard against the recurrence of the shortage, and a little receiving and storeroom was created, and placed in charge of the foreman.

In this storeroom, each item was given a numbered shelf or bin bearing the name and part number, and a specially labeled quantity of each important item, enough to last three weeks, was marked and kept in reserve for emergencies. This meant that a rather large amount of money was tied up without producing any returns, but Amos considered this much cheaper than a possible shutdown, a shipment of inferior buggies, or another broken delivery promise.

The Typewritten Order.—As John no longer counted in the bars of iron and checked the square inches in every hide, it was desirable to make another copy of the purchase order for the foreman, who had charge of receiving and stores.

About this time the Smith Premier Co. was marketing the old double keyboard typewriter, and John persuaded Amos to purchase one. As he had sometimes experienced difficulty in matching invoices with order copies, he arranged to have the purchase order copies printed and numbered in triplicate. One copy was to go to the vendor, one to the storekeeper, and one was for the office file.

The Purchase Schedule.—At this stage of development Smith was still a general office man, who, in addition to his other duties, handled the purchase-routine, and wrote the letters; but Amos still signed all letters and orders. The office copies of all purchase orders were left bound in the book.

As the farmers of Ohio and Michigan were very prosperous, there was a great demand for the now famous Johnson side-bar buggy. Amos was still far from wealthy, and the demand for funds for the various needs of the plant kept him awake many nights. It was necessary to keep the investment in inventories at the lowest possible point commensurate with safety, but it was of more importance than ever that the plant should not be tied up for the want of some one item.

Averaging Materials and Output.—In order to solve this problem Amos and John spent many long evenings together, and this was the solution reached: they estimated that under existing conditions they could make and sell an average of ten buggies per day for the next fifty weeks, or a total of three thousand buggies. They, therefore, drew up a schedule of all the items needed to make those three thousand buggies, and gave each part a part number. The next step was to make a stock record card for each item, showing at the top the name and number of the part, the number of the bin in the stock room, the number of pieces on hand, the estimated requirement for the next fifty weeks, the amount ordered, order number, firm, price, amount received, and amount issued.

It would require a good deal of careful attention to keep this record up-to-date, but they believed it would be well worth while, because it would accomplish three things: (1) assure continuous flow of needed materials; (2) keep the stock all live; and (3) keep the inventory investment at the lowest possible point of safety.

The Perpetual Inventory.—Amos, John, and the stock

room clerk had many discussions as to where this record should be kept and how it should be kept. The storekeeper wanted to keep the card record of each item on the bin, where he could always see that the record of goods on hand corresponded with the goods actually in the bin.

This is an excellent way to keep the records in accord with the goods on hand, but it has several rather serious drawbacks. If the cards are kept on the bin they must of course be dusty and dirty, as the records must be made by the storekeeper, whose hands are often dirty. The cards would always be hard to read, and would always be inconvenient for the office force to reach.

The storekeeper next wanted the cards kept in a card file on his desk. This would keep them cleaner, but they would still be inaccessible to the office.

After viewing the problem from all angles, they finally decided to keep the card file in the office, and have it compared with the stock on hand every six months.

The Modified Record System.—This perpetual inventory and purchase order record worked well for the first few weeks, but it soon became evident that the record clerk was lost in the maze of cards. She never could tell whether a quarter by quarter by half tee was the same as a half by quarter by quarter, or whether F. H. B. meant flat head bright or flat head blued screws. It soon became evident that this card index must either be turned over to an expert, or that it must be simplified.

The next step, therefore, was to eliminate all cards for unimportant items, and to keep a detail record on major items only. There was no point to spending three dollars' worth of time keeping a record of one size of screws, when their total purchases of that item did not exceed fifty dollars for the year, and they could always pick them up at the local hardware store, in case of necessity. This change brought the stock record file down to a usable size, and kept it up to a high point of efficiency at minimum cost. For instance, Smith always knew just how he stood on spoke dowels, but he neither knew nor cared whether he had on hand ten or fifteen gross of a certain sized screw which cost 40c per gross, and could be secured locally on one hour's notice.

The Order Index.—Things had been moving along rather well now for a long time; in fact they had gone so smoothly

that John began to have an uncomfortable feeling that perhaps trouble was piling up somewhere. About this time the local banker telephoned Amos to come down and take up a sight draft, drawn by a hardwood dealer in Chicago. John had mislaid the invoice, had lost the discount, and had inadvertently injured the credit of the Johnson Buggy Company, all because of an oversight.

The draft was taken up promptly, and a conference was held to determine a method to prevent a recurrence of this oversight. The scheme developed was as follows: Each firm from which they purchased materials was given a separate card in the new purchase order index. This card showed the name, address and telephone number of the vendor, the name of the salesman who handled Johnson's account, the product handled, discount terms, and the number of every purchase order issued on that firm. As each order number was closed, it was checked on the card. (See Order Index card, page 108.) The office copies of the purchase order numbers were removed from the pad and separated into two files—the open or incomplete file, and the filled order file.

The Accounts Payable Record.—John now had a skeleton of a rather complete purchase record system; namely, a commodity index on the most important items, an order index, and a filled and unfilled order file.

The business had now expanded to a point where they had found it necessary to add an auditor to the staff. He was a very capable man, but inclined to be irascible. There had been frequent arguments between John and the auditor concerning the location of invoices. Sometimes John had them, and sometimes the auditor had them, but neither had a record of the bills passed to the auditor for payment.

In order to obviate this recurring difficulty and to fix responsibility, John made up a list of the bills sent in for payment, and asked the auditor to sign a receipt for them. This worked very well for a time, but they were soon handling so many bills that the auditor could not always take time to check over the bills before he receipted for them, and the receipt became a matter of form.

About this time, the auditor introduced the voucher method of payment and asked John to list the accounts payable directly on the accounts payable sheets, and to keep a carbon copy for his files. This saved the labour of relisting all the

invoices and gave John an accurate record of all bills passed for payment. (See Accounts Payable form, page 109.)

The Salesman's Gifts.—About this time, John was appointed purchasing agent, and was given full purchase-authority. As soon as the salesmen learned that it was John who would place the future orders for the Johnson Buggy Co., he became very popular. This was several years before the war, when a salesman really needed to seek business, and when all buying and selling was not as clean and aboveboard as it is today. John was frequently invited to luncheon, and sometimes to a theater and supper party, and his desk was littered with cigars and cluttered with note-books, paper weights, rulers, and advertising inkstands.

Frequently the salesman for one of the leather houses would send him a hand-tooled leather trinket, and one day he even inquired what size shoes and gloves he wore, what size shoes his wife wore, and what colour she preferred.

Gifts or Graft.—Just where to draw the line between the gifts he could rightfully accept and those that he could not accept, was a thing which John found very difficult to determine. The next time the salesman talked shoes and gloves, however, he asked him whether his firm actually made shoes and gloves, and the salesman admitted that they made gloves, but not shoes.

John then said that he did need a pair of gloves, and would be very glad to have his salesman friend supply them, provided he could purchase them at the regular wholesale price. He assumed that the salesman had merely intended to save him the retailer's profit on these items, and he would be very glad to accept this small favour in the spirit in which it was offered.

The salesman readily agreed to this, but a few days later sent to John's office a handsome pair of gloves and a receipted bill for \$2. At the same time, he sent to his house three pairs of gloves for Mrs. Smith, with his personal card, saying that this small gift was sent her because of his great regard for John.

What would you have done under these circumstances? Would it make any difference if you were about to make heavy purchases of leather? What difference?

A Subtle Influence.—Mrs. Smith was delighted, both with the gift and with the compliment to John, but he was in a

quandary. His solution of the difficulty was found in an invitation to the salesman to lunch with him at his club next day. After the luncheon was well under way John asked the salesman whether he had ever been on the purchasing agent's side of the desk, and then began to outline the position of the purchasing agent as he, Smith, saw it.

He wound up the discussion by remarking that the salesman no doubt had never viewed the matter in this light before, but that it was no kindness to the purchasing agent to thrust these gifts upon him. On the contrary it merely put him in the position where he had to choose between hurting a friend's feelings and running the risk of having his own motives questioned at some time in the future. As between the two, he frankly preferred to wound a friend or even risk losing one.

The Follow-Up.—The business of the Johnson buggy plant had now grown until John had to devote practically all of his energies to the purchase of supplies and material. He was now issuing about one thousand purchase orders per month. In such a volume of orders, a certain percentage of them were necessarily slow, and John began to consider seriously the desirability of adding a tracing system, and a tracing clerk, to his department. His filled and unfilled orders were arranged numerically in two separate files, and the only tracing done was a periodic thumbing through the oldest orders in the unfilled file.

He considered the addition of a fourth copy to his purchase order blanks for tracing purposes, and the institution of an order acknowledgment and daily follow-up system. This would mean, however, rather more expense than he cared to add at this time; so he compromised by adding the fourth copy, but separating this into two files, one urgent and the other routine.

He soon found that most of the routine items and a large percentage of the urgent items were cleared automatically, without tracing. The next step was to send the fourth copy to the inspection department, and merely to record in his daily tickler file the numbers of the orders which required a special follow-up.

The New Plant.—About this time the buggy business began to feel the competition of the automobile, and after many consultations, Amos Johnson incorporated the Johnson Automobile and Buggy Co. and, with the aid of a local capitalist,

began the erection of a modern factory building to be given over entirely to the new industry.

The purchase of the machinery for this new plant was by far the largest purchasing problem John had ever faced, and before he began to place orders he spent two weeks with the buyer for the largest automobile plant then in existence. As a result of this visit, he had a definite plan of action.

As soon as the factory superintendent had made ready his layout and lists of machines, John had them arranged on sheets, a separate sheet to each section in the plant. These sheets showed the type, number, and name of every machine in each section, the estimated cost, date needed, and point of shipment. As soon as each machine was ordered, he set down in parallel columns the actual cost, the terms, date of shipment promised, and date to begin tracing. In addition to these sheets, he placed the tracing date in his daily tickler file.

With these lists and the help of an old railroad man to follow through the shipments, he had no difficulty and the plant opened up on schedule time.

The Daily Statement.—The purchase of all this equipment meant rather a heavy drain upon the treasury, and in order to keep purchases constantly related to funds available, John suggested that he submit to the treasurer a daily report showing the approximate value of purchases, the amount of the invoices certified for payment, and the amount of product billed to vendors. This report proved to be of great service.

Cash Discount Data.—At the end of the first year's operation, John was compiling a report showing the number of purchase orders issued, the monthly stock balance, and the amount of cash discounts taken, when his attention was called to a cash discount item of 47c which had been lost because the bill was delayed on the invoice clerk's desk. He had always prided himself upon taking all cash discounts, but now he began to wonder whether he was not overlooking some.

Upon analyzing the bills for the past six months, he discovered that an indolent clerk was losing more cash discounts for the firm than her salary amounted to. Thereafter he called for a monthly statement of discounts lost, and this item of waste was cut from many dollars to a few cents per month, and the credit rating of the corporation was further improved.

The Pending File.—Up to the authorization of the pur-

chase of machines for the new plant there had been no apparent necessity for a careful record of quotations, but with this rather large job it seemed essential to devise some means of recording this data.

Accordingly, every job on which inquiries were mailed was given a job number, and all the papers relating to this job were filed under that number. When the order was placed the order number was recorded on the job file, and the job number indexed on the purchase order. For convenience, data sheets and inquiries were all size $8\frac{1}{2} \times 11$. When there were a great many papers and samples relating to a job, the whole file was placed in a heavy manila envelope bearing the job number on the outside. This plan worked admirably while there was a large number of jobs that were kept pending for a long time before the orders were placed.

As soon as the equipment purchases were completed, however, the job number was discontinued, and the papers relating to a given purchase were filed under the number of the purchase order. No number was assigned until the purchase was completed. The papers relating to all pending jobs were filed alphabetically under the name of the item in a pending file. For convenience these subsidiary papers were called contracts.

Reputation at Stake.—Incidentally, this plan of filing all quotations under the number of the purchase order saved John considerable embarrassment on at least one occasion. He had sent out five requests for quotations on three car loads of crating lumber, and one of the requests went to a dealer who happened to be a close personal friend of Amos Johnson. The lumber dealers had a price agreement, and all quoted the same price. With one dealer, however, John had a private agreement that all purchases of a car load or over would take a cash discount of five percent instead of the usual two percent.

Amos Johnson's friend followed up his bid in person and became quite excited because he did not get the business. He even went to Amos and charged that Smith was feathering his own nest by placing these lumber orders elsewhere, because he knew none of the dealers would openly cut the price. Amos called for the papers relating to the purchase.

The filing system was so simple and so complete that John was able to produce the whole file without delay. If, how-

ever, he had not been able to supply the data requested promptly, it might have embarrassed both him and his employer.

The Reasons for a Purchase.—There are, however, sometimes good reasons for making a given purchase from a certain source, which do not appear on the face of the transaction. For instance, let us assume that you are in the market for a quantity of grand pianos. There are two makes of grand pianos that cost about the same. The greatest living artists are about equally divided as to their preference for one or the other. The piano which is, perhaps, first choice, will cost fifteen dollars less than the other. It would seem natural, therefore, to purchase the cheaper piano. It may happen, however, that you rent a great many pianos at a very low rate from the firm that sells the higher priced piano. Will it not be better to purchase this instrument, even if you prefer the other at less cost? You will, no doubt, call the attention of the piano sales manager to the fact that you are actually paying more money for a piano which does not appeal quite as much to you personally, simply as a mark of appreciation of the way he has handled your piano rentals. In the course of a year this may save you many dollars.

This is an excellent illustration of the fact that in many purchases there are important factors which do not appear upon the surface, of which the outsider cannot be informed, and concerning which he should not be permitted to inquire. Any man or firm who attempts to check up too closely the actions of his purchasing agent will, by that very act, deprive him of much of his usefulness.

The Merger.—About this time, the Johnson Automobile and Buggy Co. and six other factories were merged into the Associated Automobile Factories Co. and John Smith was appointed general purchasing agent for the new corporation. His first act after appointment was to make a three-day visit to each of the other factories. The object of this visit was to acquaint himself with the layout and the personnel of the other purchasing departments. While going over details with the head of each purchasing department, he tried to learn just what weaknesses and what points of strength each possessed.

The Systems Enthusiast.—The buyer in Factory A was a young man who was a systems enthusiast, and had so much office machinery that his department was unduly cumbersome

and unduly expensive to maintain. He had apparently taken over bodily certain bits of office system, and tried to put them to work for him. In other words, instead of determining what office records were essential, and then finding the system that would do that bit of work most efficiently, he had confused the means with the end. The office served the system instead of having the system serve the office. System and office machinery may be very excellent servants, but they are often hard taskmasters. It may not be amiss to remark in passing that most young purchasing agents who are given a free rein will introduce too much routine, and that many more experienced buyers will tend to err in the other direction.

The Remedy.—In order to remove this difficulty without injuring the feelings of the buyer, Smith asked him to explain minutely what each bit of routine was for, and whether it actually justified its cost. After going over the whole matter, he merely remarked on leaving that it seemed to him, after this rather superficial discussion, that there were perhaps some bits of routine which were not paying their way, and suggested that he check up from that viewpoint, and talk with him about it again soon. In any case, no changes would be made at the present time which the local buyer did not approve.

The next time John called on this man, his office routine was much lighter, much more efficient, and much less expensive.

Every bit of routine must justify itself. If a given record costs one thousand hours' time each year, and this record is used once each month, and if the facts could be got at when needed with a total expenditure of five hours each time they are called for, that record should be eliminated, unless there is some special reason why the data must be available at once.

The "Grouchy" Buyer.—Smith next called on the buyer for Factory B. This man was a buyer of the old school, who barked at everyone, tried to scare the office boy to death, and carried a large chew of fine cut in his left cheek. With this man John went over matters superficially the first day. In spite of the fact that he disliked the man's manner, and was confident that it was indirectly costing the firm a good deal in the lessened efficiency of the office force, and the lack of regard on the part of the salesmen, he offered no suggestions until he was about to leave for the day.

Just as he was putting on his coat, he casually inquired whether Buyer B had ever tried to put himself in the shoes

of the salesmen whom he accorded such scant consideration, and whether he was conducting the sort of office he would like to have his small boy work in, if anything should make it necessary for him to go to work. Then, before he could answer, John added that he was going to run home for a day or two, but would drop in on "B" again some day next week.

When he did return the next week he was amazed at the improvement in the general atmosphere of the office.

The "Fussy" Buyer.—The buyer for Factory C was a nervous, fussy little man, who seemed to be weighed down with a sense of his own importance, and the importance of his job. He was always rushed to death, and never seemed to get anything done. He never seemed to be happy unless he was nearly buried in a flood of papers above which he could merely raise his head and snarl. With this man John made an appointment for seven-thirty the next morning.

The first thing he did was to move out the buyer's big old roll-top desk, replace it with a 60-inch flat-top desk, and trade his uncomfortable old hard-bottom chair, that always had one leg off the floor, for a new swivel chair that sat level and had a perforated leather seat. Next, one by one, he dumped the contents of each drawer on the top of the desk. He saw to it that nothing went into the drawers of the new desk that was not essential. About one-fourth of the material in the old desk went into the files, about one-half went into the waste-basket, and the remaining one-fourth was left on top of the desk.

This data he divided between material awaiting action by some one else, which was put into a letter tray in the second drawer on the left hand side of the desk; and material for attention today, which was consigned to the letter tray in the top drawer on the left hand side. Only papers being used were to be kept on top of the desk, and each paper was to be disposed of in regular order. The contents of the basket in the top drawer were to be gone over the first thing each morning to avoid overlooking any important matters. After so organizing the work for Buyer C, he left him for the day.

The next morning he had a frank talk with him, pointing out the handicap under which "C" had permitted himself

to work heretofore, and expressing faith in his ability to get on top of his job instead of permitting it to ride him.

The Good Fellow.—The buyer for Factory D was of the type commonly known as a good fellow. Everyone liked and spoke well of him. The principal difficulties he experienced, however, were getting his work done, and in keeping the cost of his purchases down. Much of his time was taken up in conversing with callers about matters which did not pertain to business. Everyone who called told him his troubles, the latest bit of gossip, and the latest skits. It is true that he acquired a miscellaneous collection of data of more or less value, but it was at the cost of far too much time.

His Development.—Just how to help Buyer D to conserve his time without hurting him, and without causing him suddenly to become too abrupt with his callers, was a problem to which John gave a great deal of thought. After watching this man, and after working with him for several days, he came to the conclusion that this buyer really possessed an unusual faculty for getting his work out with the expenditure of a minimum amount of time and effort, and that he had fallen into the habit of wasting time with casual callers because he felt that he had the time to spare. This habit had, however, become so fixed that it threatened to impair his usefulness.

John Smith decided to try the experiment of loading him up with work. Next morning when he came down he brought two copies of the specifications for equipment of a proposed plant for the construction of automobile trucks. He laid one copy of these specifications on the desk of the buyer for Factory D, and asked him to analyze the data and let him have his criticisms, suggestions, and cost estimates as soon as he conveniently could, without interfering with his regular work. The list was so long and so technical that the average buyer would have taken ten days to two weeks to study it before making any report.

Getting Down to Business.—There was at once a marked improvement in the way Buyer D handled his work. Every salesman who approached was given the same hearty handshake and the same jovial smile, but he was given no opportunity to discuss anything but business. The routine work was kept up to date, and everything moved along smoothly, but somehow or other Buyer D managed to devote a very

considerable amount of time to the study of the specifications, and in just a week he submitted a masterly criticism of the whole schedule.

He criticized the size and location of the power plant, recommended the substitution of electric for oil-burning furnaces, and justified his recommendation by statistics. He recommended a new type of furnace door lining, and cited the theoretical saving it would effect; called attention to the insufficiency of the space allotted to the employees' dining and recreation rooms, and suggested wider alleys for trucking materials.

So complete and comprehensive was this analysis that John decided to refer to him a number of similar files. The result of the visit was that Buyer D was made Assistant General Purchasing Agent at an increased salary. Apparently the only thing necessary to bring out this man's dormant powers was the demand for extra service.

The Impulsive Buyer.—The next branch buyer John Smith called upon was a young man whose general record was good, but who occasionally made grave errors in judgment. He would, however, go along for months at a time, turning out an amazing quantity of work of high quality. He had been favourably considered for promotion on several occasions. Every time the president of his firm had about decided he had finally found his feet, he would make a bad error in judgment. John Smith had a feeling that this man would probably present more of a problem than had any of the other buyers, so he deferred calling upon him until next to the last. He felt that this man could be developed into one of the most valuable assistants on the list, if he could only devise some means of preventing a recurrence of these mistakes.

Value of a Good Chief Clerk.—Accordingly, Smith arranged to make Factory E his headquarters for a few weeks, in order to study this buyer at close range. It just happened that Buyer E had a very good chief clerk, who checked over his most important transactions with him. This chief clerk was a woman who had been with the firm for many years, and had a firm grasp of the details of the office.

Smith had not been working alongside the buyer for E Plant very long before he noticed that he never spent much time in the analysis of any problem. He also noted that the

chief clerk not only checked over all the orders after they had been typed, and before they were mailed, but that she usually took the time to check over carefully all the papers relating to the purchase before she brought the order in for signature.

Occasionally, however, the purchasing agent would determine upon a purchase while the chief clerk was out of the office, and would have the order typed, signed, and sent out before she returned. After Smith had been watching this buyer for a week, he closed up a purchase of one thousand inner tubes, "like sample submitted," at a very low price. The order did not carry any other specifications, and the salesman was permitted to carry the sample away with him. When the material was delivered, the quality was so poor that the whole lot had to be refused. This led to a long discussion, and a lawsuit was narrowly averted.

Apparently, this buyer belonged to that rather large group of men who feel that they have attained a position where it is just a bit beneath them to check over details carefully. He had forgotten that success is generally the result of the consistent exercise of an infinite capacity for detail.

The Importance of Detail.—As soon as Smith was satisfied that he had hit upon the true reason for these unfortunate errors, he asked the President for a careful analysis of this man's history, and a statement of the several occasions when this man's name had come up for discussion, both favourable and otherwise and the many times that he had been considered for promotion.

With this record before him, he asked the buyer to return to the office after luncheon the next Saturday afternoon, in order to check over some details before he left town. He wanted to talk with this buyer when he would not be interrupted, and he wanted to talk with him on Saturday afternoon in order to give him Sunday to think things over.

Tactful Talk Succeeds.—When they were alone in the office, John Smith said that he had been trying for weeks to find out why a man possessing "E's" ability was still only purchasing agent for a branch, when men who had much less ability were heading their own concerns. He had looked up his record and had found that on three occasions the directors of his concern had been upon the verge of electing him a vice-president, but that each time he had lost the promotion

because of an unfortunate error in judgment. He had been studying him carefully, and had come to the conclusion that the reason for these unfortunate errors was his distaste for details, and his apparent feeling that his time was too valuable to spend upon them. He was convinced, he said, that it was not yet too late for him to achieve this promotion, but it would be necessary for him to demonstrate that he could and would handle all essential details, in order to make sure that he would not repeat these expensive errors. That was more than a year ago, and this buyer is now in line for the next official vacancy.

The Buyer with Family Worries.—The last buyer Smith had to check up presented a new sort of problem. The man had been with his company for many years, and had originally been one of the most promising men in the official family. During the last two years he had apparently been worried by affairs at home, and the quality of his work had suffered. His income was modest, and his family were not only using all his salary, but they were continually asking him for things that he could not afford to purchase. Living expenses in that city were very high, and the man was having a hard time making ends meet. His wife and daughters had got in with rather a fast set and they were, no doubt, living beyond their income.

Without saying anything to the buyer, Smith arranged to have him transferred to one of the other factories where the living expenses would be somewhat smaller, and where he could earn a larger salary. With the slightly greater income and the smaller living expenses, with the wife and daughters separated from their extravagant friends and neighbours, Smith was confident this buyer would get a new grip upon himself. When Smith visited him in his new location six months later, he looked like a new man, and seemed to be able to turn out twice as much work with half the effort.

The Coördinated Purchase Machine.—Now that John Smith had visited the buyers for all the plants he felt that he had one of the most efficient buying forces in the country. The next problem was so to coördinate the purchases of these branches that each plant could take advantage of the most expert knowledge in the whole organization.

He learned that the buyer at Plant A was a coal enthusiast. The buyer at Plant B was a student of rubber goods, and C

was most interested in machinery. Upon going over the list of the most important items he was able to assign each one of them to one of the buyers. The result of this new division of work was that each local buyer continued to handle the routine purchases for his particular plant, and in addition he submitted specific recommendations for the purchases of certain items for all the plants.

Capitalizing Enthusiasm.—In this way the general purchasing agent had the advantage of the experience and the enthusiastic coöperation of one or more of his assistants in the purchase of each important item for all the plants. All these more important purchases were of course referred to the general purchasing agent before negotiations were completed. In addition to this valuable assistance, he developed a spirit of friendly rivalry that went a long way toward the reduction of material costs, without in any way reducing quality, and without tying up large amounts of money in inventories.

CHAPTER IV

QUALIFICATIONS FOR SUCCESS

Requirements Are Exacting.—In the last chapter we pointed out some of the handicaps under which some purchasing agents have to work. Perhaps it would be well now to list the qualifications for a successful purchasing agent. In attempting to draw up specifications for a purchasing agent, I find that the requirements are so rigid that any man who could measure up would be assured of at least a modest success in any line of business. The business of spending other people's money is so exacting, calls for so many varied qualities, and for so much specialized information, that few can achieve the high standard set for the really successful purchasing agent.

Education Essential.—The man who is really qualified must of necessity know a great deal about the things he purchases. It is, of course, true that there are many purchasing agents who are not well informed. You will find many bluffers in every line. Sooner or later, however, these men are found out, although if they last long enough they may acquire knowledge and experience.

The successful purchasing agent must be well educated. This does not necessarily mean that he must be a graduate of a university or college. There are a great many well educated people who have never attended college. There are even some well educated men whose school days ended in the eighth grade. These men have, however, acquired a high degree of education because they have continued to learn, and have retained the attitude of the student throughout their entire business lives.

Integrity Essential.—No doubt some of my readers feel that integrity should have been listed as the first qualification. It is of prime importance that the purchasing agent be possessed of a brand of integrity that is beyond question. I have placed training first because it is possible for a trained man to serve his firm rather well, for at least a short time,

even if he is not honest. If he is honest, but is wholly lacking in training he will lose money for his firm every day. I am assuming that the untrained man is untrained because he lacks either the desire or the capacity for study. Many men who possess a degree of training, but who are not experienced in the work of the purchasing agent, are so pugnaciously honest that the effect upon the men with whom they do business is bad rather than otherwise.

Even Temper Essential.—To the uninitiated it might seem that the buyer has all the cards in his hand, and that he, if anyone, can afford to lose his temper. They feel that in the encounter the man who is trying to sell the purchasing agent must have a good deal of self-control, but the buyer can do about as he pleases. There are many salesmen who feel that the purchasing agent is placed in his position to make it difficult for them. They resent his very existence, and often deliberately bait him.

It takes a good deal of self-control to be courteous to the carbon paper salesman who insists upon talking his wares when he is the fifth such salesman that morning, and when the buyer's desk is piled high with papers demanding attention. It takes a fairly level head to listen to his chatter while you are trying to sign your mail and to answer two or three telephone calls at the same time. It takes a man with an even temper to keep from expressing his opinions in forcible language when the manufacturer refuses to sell him because the jobbers have filed a complaint. Many times it would be a relief to tell the disgruntled vendor who has lost the order just what you think of a poor loser. Perhaps the frank expression of your feelings in this matter would be justified, but as a matter of policy it pays to keep that sort of information to yourself. As a matter of fact, it pays to keep all your information to yourself in talking with salesmen.

In the last analysis the purchasing agent is just as dependent upon the good will of the salesman as the salesman is dependent upon the good will of the purchasing agent. One of the best ways to lose the friendship of the men with whom you do business is to tell them exactly what you think of some of their business tactics. The really valuable purchasing agent must, therefore, be even tempered and self-controlled.

Must Be Friendly—One of the most valuable assets any man can possess, whether he be a purchasing agent or not, is

friendliness. Some people call a man gifted in this way a "good mixer." Whatever name you give it, this quality of friendliness, this ability to get on well with people, rests upon a genuine liking for them. If you like anyone, it is comparatively easy for you to make him like you. If you do not like a person it is not easy for you to make him like you. Many men are born with this liking for people—just people in general. But many are sadly lacking in this quality. It is, however, a quality that may be profitably cultivated. If you think uncomplimentary things about any one it is not easy to say things that are complimentary. The cultivation of friendliness, therefore, rests upon your ability so to control your thoughts that you will habitually think pleasantly about people with whom you come in contact.

This does not mean that you should shut your eyes to all their faults. There are, however, some admirable qualities in everyone. If you will diligently search for these qualities, and will strive to think and talk about these traits, you will soon find yourself liking the person who possesses them. If ability to like people did not pay in any other way, it would be worth while cultivating it because of the pleasure you will experience from keeping your thoughts and conversation on your more pleasant contacts with them. This is merely another way of saying that you should practice the Golden Rule, because it pays, and because it makes you and all your associates happier, more agreeable, and more efficient.

Keep Your Own Counsel.—Many purchasing agents have cost their firms much money because they have talked too much. It is never advisable to tell what you are going to do, or buy, until you have done it, and even then there can be no profit in telling the world what you have done. You should be too busy doing things to have any time to talk about them. The purchasing agent who has learned to keep up his end of any conversation and be agreeable, without telling his own affairs, is on a fair way to success. One seldom learns anything while talking. One's information is secured while listening to the conversation of others. If you will cultivate the art of being a good listener, you will never experience the embarrassment of having your plans spoiled because you have told them to the wrong person at the wrong time. If you would succeed, then, study, be self-controlled, be friendly, and keep your own counsel.

The Measure of Success.—No doubt this list of qualifications might be lengthened, but in these five prime essentials you have the foundation for a successful career. Success is measured in many ways. There are many successful purchasing agents who do not make a great deal of money, just as there are many successful teachers who do not receive much money. Success might better be measured as the achievement of recognition—recognition of the ability to do the thing one has set out to do a bit better than it has been done heretofore.

CHAPTER V

THE ETHICS OF THE PROFESSION

Definition and Illustrations.—For our purposes ethics may be defined as the accepted standard of conduct. This standard of conduct varies not only with the passing years, but also with localities, and even with groups of individuals in the same general locality. There was a time when it was considered quite all right for a man to go wooing with a club, and to drag his bride into his cave by the hair of her head. Such conduct would not be considered ethical today. There was a time when it was quite according to the accepted code of conduct for the gentry to conduct private raids upon their neighbours, and upon travellers, in order to replenish their own coffers. This practice is now generally frowned upon. There was a time when it was considered rather a mark of weakness to pay one's debts. Most people today feel constrained to pay at least most of their debts. There was a time when every buyer was expected to receive a secret commission on the orders he placed. A little later the unpleasant word "graft" was applied to this practice, which finally became so obviously out-of-line with the modern ethical standards that this sort of transaction has almost disappeared. Even the so-called "honest graft" of politics is frowned upon.

Some Lag Behind Ethical Standard.—With every change in the ethical standard, there is always a larger or smaller group of individuals who lead, and a group who lag behind. The group in the lead are considered Puritans, and the group who lag behind usually do so because they have entirely failed to sense the change. The new attitude of the modern purchasing agent toward graft in all its forms, and in its wide variety of dress, has even yet not been recognized by certain members of the profession, nor by an even larger group of salesmen, although their education is progressing.

Sales Tactics.—You still find the salesman who solicits orders with the aid of silk umbrellas and theatre parties. You

still find the buyer who invites the salesman to a quiet little poker game at his home after he has been awarded a large order. Some of these buyers have the grace to win only 10 percent. of the face value of the order at the poker game. Some of the salesmen lose more. The trouble is, these men have simply failed to recognize the change in the accepted standards of conduct.

Some Industries Lag.—In every change in the accepted standards of conduct, some groups of individuals lag. This has been particularly true of certain industries. One of the last industries to make a concerted attempt to put its house in order was that of the paint and varnish manufacturers. There are still some flagrant cases of commercial bribery in this line of business, but the Federal Trade Commission is making it so unpleasant for the offenders that even they will have to conduct their business more nearly in accord with the accepted standards of business conduct in the near future.

Department of Justice Prods the Laggards.—Both the Federal Trade Commission and the Department of Justice have helped materially in speeding up this process of the ethical readjustment of business habits for many firms and groups of firms, as is evidenced by the following notices taken from trade journals:

Exhibit A.—Extract from “Drug and Chemical Markets Magazine,” Jan. 7, 1920.

DAMAGES FOR COMMERCIAL BRIBERY

The Woolen Mills has recovered \$25,000 from the Soap Co., of Boston, in a suit involving the question of bribery of employees of the Company. The Company also sued, former superintendent, and obtained a judgment for \$16,000, being the amount of commissions received by him. The bribed employees were sentenced to three months in jail and were also heavily fined.

The suits were brought about by the Department of Justice. Officers of the Soap Mfg. Co. were indicted on a charge of conspiracy to violate a section of the postal laws prohibiting the use of the mails in furtherance of a scheme to defraud. It was decided by the Court that an arrangement to pay graft is a scheme to defraud the employer.

Exhibit B.—Extract from “Purchasing Agent,” August, 1921, p. 58.

TRADE COMMISSION CITES GLUE MANUFACTURER

A complaint was recently issued by the Federal Trade Commission against Philadelphia, covering an alleged violation of Section 5 of the Federal Trade Commission Act. Specifically the complaint charges the firm mentioned with giving cash commissions or gratuities, usually amount-

ing to 5 cents a pound, to superintendents, and other employees of cabinet manufacturing plants, without the knowledge and consent of the employers, to influence the purchase of the products of the respondent. The complaint goes on to say that the total sales of glue by the respondent exceed \$500,000 annually, and that gratuities given to the superintendent and other employees of one of its customers, during the two-year period ending January 1st, 1921, aggregated approximately \$34,000.

The company in question was required to file an answer to the complaint within thirty days of its issuance.

It is unfortunate that there are always a large number of people who think almost anything is all right until they get caught. For them the activities of the Federal Trade Commission and the Department of Justice will prove a powerful and beneficial stimulus. For the great body of salesmen and representatives, such examples are entirely unnecessary.

Liars Will Come to Grief.—There are a good many practices in certain lines of business, however, that are not subject to the jurisdiction of either the Federal Trade Commission or the Department of Justice, yet are just as much to be censured. The practice of telling anything that is not true for any purpose is not in accordance with the present standards of ethical conduct. The purchasing agent who permits himself to make a statement that he knows is not true will sooner or later come to grief. There are mighty few men who can tell a lie in a convincing manner, and even fewer who have sufficient mental agility to keep up with the lies they tell.

One of the best trade assets any purchasing agent can acquire is the reputation for never overstating anything. It is decidedly better to have the reputation for conservative statements than for even a small group of your business acquaintances to feel that you occasionally colour a statement to make it serve your ends better. Because you want to acquire the reputation for always doing the thing that you say you are going to do and because you do not want to be in the position of just doing a thing because you said you were going to do it, it is well for you to be very reluctant to make any definite statement or any definite promise. Many of the promises made by the purchasing agent in an honest endeavour to help someone else out cause him more worry and grief than they save.

Securing Inside Information.—Many salesmen use sales methods that are not ethical, but that does not justify the

purchasing agent in resorting to similar tactics. Many salesmen deliberately "pump" the stores and clerical forces in order to secure inside information, and use this knowledge to their own advantage, and to the disadvantage of the purchasing agent.

That does not justify the purchasing agent in reading the salesman's confidential price instructions when he inadvertently leaves his bag in the buyer's office. Even if there were no ethical question involved, there would always be the possibility that the salesman left these papers in your office in the expectation that you would seize the opportunity to read them, and be guided by the information they contain.

When Bids Are Confidential.—Most public institutions are required by law either to print or exhibit upon demand the bids received on any large job. With exceptions of that sort, there cannot be any possible justification for any purchasing agent telling any salesman what his competitor has bid on any job. It is true that in many cases the salesman has so many of the facts in hand from other sources that he can guess accurately what the other man has bid. We cannot very well keep him from guessing, and there can be no harm in telling him that his quotation is high, if it is, but the purchasing agent who gets the reputation of revealing to salesmen the quotations of their competitors might just as well begin to look for some other sort of work, because his days as a purchasing agent are numbered.

CHAPTER VI

THE MECHANICS OF THE PROFESSION

This Is of Secondary Importance.—It is my firm belief that the importance of the mere mechanics of purchasing is usually overemphasized. It is true that a cumbersome system may be unduly expensive to maintain, and it is also true that an incomplete system may lead to both inconvenience and delay, and may in some cases cause financial loss. In every case, however, the system which will make the greatest return for each dollar of operating cost must be determined very largely by the type of personnel.

If the men in charge of the various divisions of the department can furnish the required data when needed, and if the cost per thousand orders compares favorably with the cost of similar departments in other organizations, I am not sure that one is justified in requiring much more. In any case, any change which may be proposed should be made only after the individuals whom it affects have been thoroughly sold to the idea. There is much more profit in keeping a contented happy worker in charge of a system that leaves something to be desired than there is in installing a perfect system, against the wishes of the worker who must use it.

Consider the Worker's Viewpoint.—Many an excellent chef will open a can of tomatoes quicker and more easily with a meat cleaver than he will with a patent can-opener. If you dislike the cleaver method, sooner or later you must either really sell him the newfangled contrivance, or you must employ a new chef. If you can't sell the new system to the workers, and the system will save less than it will cost to replace the present workers, it is much better to limp along with the present system. If you cannot really sell them the new system, perhaps it is not as perfect as you think.

In the last analysis, the necessary routine for conducting the work of the modern purchasing department is very simple. The best method of approach is not to build the system and foist it upon the organization, but rather to determine first

the requirements of the organization, and then build the simplest possible system that will perform the required service. System is an excellent servant but may become a very hard master.

Genesis of the Purchase.—As most demands for material arise outside the purchasing department, some sort of "request to purchase" form must be provided. Just what size these should be, just how many copies should be made, and to whom they should be forwarded, and by what officials they should be approved before they reach the purchasing agent, will depend entirely upon the lines of authority, and the size and kind of organization.

Make the Form Fit the Job.—If the man who requires the material is a construction foreman, he will prefer to have the request to purchase in the form of a pocket size duplicate order book. For this sort of work, perhaps he will require three copies, one for the purchasing agent, one for the general superintendent, and one for his own records, with, perhaps, a fourth copy for the storekeeper.

Where there is no continuous flow of emergency orders, the request to purchase is usually made in duplicate; one copy to be routed through the hands of the storekeeper and the various executives to the purchasing agent, and one for the man who needs the material.

Forms for Office Supplies.—If most requests originate in offices and the forms do not need to be pocket size, there are many advantages in having these forms $8\frac{1}{2} \times 11$. As most quotations and most correspondence concerning a specific purchase are on sheets $8\frac{1}{2} \times 11$, it is very convenient to fasten together, or put in a correspondence size folder, all the papers relating to a specific purchase.

These papers may then be filed either numerically, under a request to purchase series of numbers; numerically, by departmental requests according to purchase order numbers; or alphabetically, by firms or commodities.

Where the file of pending orders is not large, there are many advantages in giving the request to purchase, the number of the purchase order. These may then be filed numerically, and located and refiled with the minimum amount of effort.

Quotation Forms.—In many cases orders may be placed to advantage only after quotations have been secured from sev-

eral firms. Some firms prefer to use a letter in requesting quotations. In most cases, however, a quotation form is preferable.

The main requirements of the request for quotation form is that it be of standard size—preferably 8½ x 11—and that it show plainly what it is, a request for quotation, and not an order.

While these orders are pending, the original request to purchase and the other papers should be held in the quotation file. The method of filing these requests will depend very largely upon the number of open jobs. In most purchasing departments, these may be kept in a single pending folder.

When the quotations have been assembled and analyzed, the order is ready to place. The number of order copies you will need will depend entirely upon the size and kind of organization, and the personnel.

Swift & Company's System.—The purchasing department of Swift & Company handles most of their purchases without issuing confirming orders. They give the vendor the number on the request to purchase (order number), and note the price and delivery date on this original request.

Any department ordering supplies makes out a purchase requisition or supply order in triplicate (original is white, duplicate is pink, and triplicate green), sending it to the superintendent's office, where a record is kept of stock on hand, time it will last, date of last order, etc. This is done in order to control the supplies being carried in departments. After being recorded and approved, all three copies are forwarded to the receiving office, where they are numbered. The green

44 PURCHASING PRINCIPLES AND PRACTICES

copy is returned to the department as their permanent record, the white original is forwarded to the purchasing department for the purchase of the material, the pink is kept in the receiving office on file numerically as a permanent record.

After the purchase of the supplies, the order is returned to the receiving office from the purchasing department, and the information contained thereon is inserted on the pink copy, so that the receiving office will have a complete permanent record on file, showing from whom bought, price f. o. b. and terms. When delivery is made, the date of delivery and ticket number is also shown on this copy.

From Delivery to Payment.—When goods are delivered to the Swift & Co. plant, the teamster presents the shipping memorandum showing the contents of the load. The advice of receipt blank is made out in quadruplicate, the first three copies going with the teamster, and the fourth copy remaining in the possession of the receiving office, as a check to see that the ticket is returned. The teamster brings back the third copy, duly signed by the department, as evidence that the load has been delivered, leaving the original and duplicate in the department.

Form C746-25M 416 set.

ADVICE OF RECEIPT

Nº 20914

FOR INSTRUCTIONS SEE REVERSE SIDE

DATE _____

DELIVER TO _____

CHARGE-SUPPLIES

THE FOLLOWING _____

STOCK-RAW

STOCK-MNFG.

The department then inserts the weights, description, etc., on the original, which is picked up daily by the receiving office messenger. The second copy remains in the department's possession as their record. After the original is returned to the receiving office, it is matched against the third copy, which, as stated above, is evidence of delivery of the load in question.

At this point the original supply order is taken from the file and attached to the advice of receipt delivery ticket, and goes to the auditor as his authority to make payment.

At the proper time in the receiving office, notation is made on the advice of receipt notice, of the name of the firm from whom the purchase was made, and whether the shipment was a carload, wagonload, or was received by express, team, parcel post, etc., with charges paid, if any.

This system has been in force for many years, and works admirably. By this method the purchasing department is relieved of all office routine, and the buyers become much more expert along their several lines.

Wilson & Co.'s System.—Wilson & Co. use a somewhat different system, although their line of business is similar. Wilson's system is described in the following statement by E. B. Kitzinger, General Purchasing Agent of Wilson & Co., under date of January 12, 1922:

"All purchases are made from requisitions furnished by the department foremen and the general store room after they have been approved by the plant superintendent. These requisitions specify the commodities wanted and when needed; also the stock on hand and how long the stock will last; thereby giving both the buyer and the superintendent a guide with which to see that the quantities are proper and not excessive. The requisitions are furnished the purchasing department on a form known as 'Foreman's Purchase Requisition.'

"Inquiries for prices on all commodities are sent broadcast to sellers in logical territories so as to give a broad field to the competition.

"In awarding contracts, quality is given first consideration; also price, delivery, specifications and other conditions which may relate especially to the commodity in question. Therefore, price is not the sole determining factor.

"After orders have been placed and foremen's requisitions properly filled out showing the prices, terms, and proper speci-

46 PURCHASING PRINCIPLES AND PRACTICES

Foreman's Purchase Requisition				Approved Estimate No.	Reg. No. _____ Date _____
On Hand	With Last Date	Desired	When Needed	ORDERED FOR _____	CHARGE TO _____
Fill in these spaces					
	AMQ	SAVE	DELAY	FOR PRICE ONLY	
<p>This part is made out by Department Foreman who sends it to Superintendent's Office for approval. Then it is sent to the Purchasing Agent who approves it and gives to Buyer.</p> <p>Duplicate on yellow is retained by Department Foreman for his record.</p> <p style="text-align: right;">Ed.</p>					
Do not write beyond this line.					

b. B. CHICAGO
DELIVERED Cash Due: _____ Days, Net: _____
200 Pgs. \$3.25

Purchase Agent's Approval _____
Ordered by _____ Approved _____ Supl.
Purchased by _____ Date _____

FORM B-498 BM 687B 4-21

41st St. and So. Ashland Ave.
CHICAGO



IMPORTANT

Date _____ 192 _____

Please furnish on our account on order No.

Confirming order given Mr.

PER	PRICE	TRADE DISCOUNT

All use subject to [ebookboom.com/terms-and-conditions](#)

F. O. B.
 Terms: { CASH { —%— Days
 DISCOUNT Net—Days

Benzodiazepine tolerance

IMPORTANT Invoice with Bill of Lading must be mailed to us on day of shipment. All invoices dated from the 10th to the 25th, inclusive, are payable first of month; all from 26th to 9th, inclusive, payable 35th of month. Less 2 per cent discount, provided articles have been received. No charge for packages or drayage will be allowed. Freight and shipping charges must be prepaid on all goods purchased delivered. This company will not be responsible for goods furnished without an order from our purchasing agent.

Ordered for

Date Reg.

Ordered by

Carregos

Date of Birth

Purchased by

ficiations of the commodities bought, they are then copied on a requisition form consisting of five copies. The first copy—form S-483—is sent to the party from whom purchase is made. The second copy is a plain sheet and is retained in the purchasing department letter file, attached to complete correspondence on the purchase. The third copy—form S-377—after it has been approved by the purchasing agent for price, terms, etc., is sent to the voucher department and is used by them in checking the invoice. The fourth copy is sent to the receiving department as a guide to that department as to what is to be received by them in order that not only proper preparation can be made for the receipt of material purchased but also to guard against over deliveries especially on declining markets. The fifth copy is furnished to the general store room or the department foreman as a notification of purchase, also as a price guide.

[Form S-377-16M Revs 4-21]

THIS COPY FOR
VOUCHER DEPARTMENT

PURCHASING DEPARTMENT

REQUISITION

Date	192	No.		
		PER	PRICE	TRADE DISCOUNT
<p>This part goes to the Voucher Dept. as their guide for payment of invoice. Duplicate on yellow goes to Receiving Office for record, and triplicate on white tissue goes to Department Foreman.</p>				
ABOVE MATERIAL TO BE SHIPPED BY E.I. 192				

Purchased From

F. O. B.
Terms: {
CASH DISCOUNT } —% Net ___ Days
Discount ___ Days

Approved by _____

Ordered for	Date Req.	Ordered by
Charge to	Date of Pur.	Purchased by

"When goods are received, a receiving report is made out by the receiving department and sent to the voucher department where the purchase requisition, the receiving report and the invoice are matched, and if correct, the invoice is paid after it has been approved by the department foreman for quality of goods. It is thus unnecessary for the invoice to be referred

to the purchasing department from the voucher department unless there is a difference in the price, quality or quantity of the merchandise received.

"The purchasing department is also closely in touch with receipt of all materials. They inspect the quality and quantity of goods received to see that they are in line with contracts made. Many commodities are purchased on certain required standards, and it becomes the duty of the receiving department to take a representative sample of each consignment received and refer it to the proper department for test and determination.

"The Company maintains a large laboratory which is used to advantage in analyzing comparative values and in determining that deliveries are in accordance with contract specifications.

"A price record is kept in the purchasing department on index cards that are filed alphabetically under the names of the commodities. These cards provide space for price, discount, terms, from whom purchase is made and the quantity bought, which information is copied from the foreman's requisition after purchase has been completed.

"Foremen's requisitions are then filed in the purchasing department for future reference."

Disposition of Purchase Order Copies.—This complete system fits the personnel and the requirements just as the Swift & Co. system fits their requirements. In most purchasing departments, however, all orders are confirmed, the purchase order being issued in from two to ten or more copies.

Obviously, one copy goes to the vendor, and one is retained in the purchasing department. Usually a third copy—often without showing the price or the quantity ordered—goes to the stores department. Another copy may go to the department requesting the goods. A copy may go to the accounting department, or the treasurer. It may be desirable to send copies of the purchase orders to several other officials because of the special requirements of the various organizations.

Order Index.—Obviously, if many orders are issued, some sort of index must be provided. The simplest form is a 4 x 6 card bearing the name of the vendor, his address, 'phone number, and such other data as may be needed—credit rating, discount terms, name of salesman, etc.—and provided with columns in which the number of the purchase orders placed

with that firm may be listed. For most purposes, this is adequate. Other columns may, however, be added to show the item ordered, quantity, date, date of payment, etc. (See Order Index Card, page 109.)

Accounts Payable Record.—One of the most frequent causes of friction between the purchasing department and the auditing or accounting department centres around lost invoices. Both departments too often feel that their routine is so perfect and their employees are so accurate that any papers that go astray do so because of the carelessness of the other department. A very simple remedy for this trouble is a duplicate accounts payable register sheet.

This may be merely a typed list of the invoices, one copy of which accompanies the invoices to the accounting department, and one copy of which is retained by the purchasing agent. This invoice register may, however, be expanded into a very useful voucher register by adding suitable columns for distributing the charges and for the voucher numbers.

Price Record Forms.—Some sort of price record form is essential for the proper handling of purchases for any business or institution in normal times. The purpose of this record is to show quickly the last cost, the quantity, and source of supply for each article purchased. The analysis of these records also easily shows the total purchases of that particular commodity over any particular period, in order to gauge accurately future purchases. Some of these records are kept in ledgers or loose-leaf binders. The most useful form is, however, usually found to be a 4 x 6 card. Complete details of catalogue filing are set forth in the next chapter.

Vendor Lists.—Every purchasing agent has experienced the embarrassment of failing to recall the source of a particular purchase that he never expected to make again, through having neglected to record it. An excellent remedy for this is found in a loose-leaf pocket size notebook, where these important sources, which are used only occasionally, are recorded under the name of the commodity. This book should be in the purchasing agent's desk at all times, so that he may quickly make the necessary entries as they occur to him during the day. These data books should be revised occasionally and brought up to date.

This, then, is the skeleton of the machinery used by the purchasing agent. There are many variations, and many re-

finements, but, generally speaking, these records will be found adequate for conducting an office handling 10,000 to 15,000 purchase orders per year.

The Routine in Brief.—For the benefit of those whose actual purchasing experience has been limited, it will be of interest to trace through a purchase from its inception to its completion.

Let us assume that the paint shop receives an order to shellac and varnish the trim in a new building. The paint foreman estimates that this job will require a hundred gallons of shellac, and one hundred gallons of varnish. He makes out a request to purchase 100 gallons of each of these items, specifying the grade or brand preferred. This is duly approved by the construction superintendent, and forwarded either to the storeroom, or direct to the purchasing agent.

It happens that the storekeeper has more than a hundred gallons of varnish and half enough shellac on hand. If the requisition comes to him, he notes the quantity he has on hand not assigned to any other job, and forwards it to the purchasing agent. If it goes to the purchasing agent first, he will no doubt check up the present stock with the storekeeper by 'phone.

Calling for Quotations.—When the purchasing agent and the storekeeper have agreed upon the quantity to be purchased, the next step is to request quotations. These requests for quotations may be made by mail, or by telephone or telegraph. The number of bids to be requested, and the firms who may be asked to bid, will depend entirely upon the judgment of the purchasing agent.

When the bids are all in, the buyer decides who is to get the order, and the order is placed by 'phone and confirmed, or it is merely mailed. This, of course, depends both upon the urgency of the need and upon the condition of the market. If the market is strong and is tending upward, naturally most orders will be placed by 'phone or wire. When the order is typed it is checked by the chief clerk in order to avoid possible errors, and sent to the purchasing agent for signature.

The receiving copy of the order goes to the receiving department in the stores division, one copy may or may not go to the paint foreman, and one or two office copies will be

filed. One office copy will be filed in the open order file either numerically or alphabetically. If there is another office copy it will be used to follow up delivery. The method of tracing varies greatly between offices, and depends very largely upon the type of organization, the type of purchases, and the location of the plant.

Environment Affects Details.—For instance, the buyer for a large construction job in a small town would need to follow up all purchases very closely in order to insure the continuous progress of the job. On the other hand, the city pick-up man for a factory in a large city would probably need to trace only the most important items. When the goods are delivered, either the invoice must go to the stores department for checking as to delivery, or the invoice and the receiving slip must be matched, either in the purchasing office or the accounting department, preferably the former. The necessary data must then be recorded on the office copy of the order, and this copy then transferred to the filled order file—numerically. The invoice will then be certified for payment, listed on the accounts payable sheets, and sent to the accounting department.

There are many variations in this routine. In fact, you will rarely find two offices which handle the routine in the same manner, but the basic principles are pretty much the same everywhere.

Typical Purchasing Forms.—The following purchase forms of the Commonwealth Edison Co. of Chicago, and the general instructions for using them are a typical example of the purchase routine in large corporations:

The requisition is written in triplicate, and after being signed by the Head of the Department, copies one and two are sent direct to the Purchasing Department. Copy number one is signed by the Purchasing Agent and is sent to the Vice-President, or Vice-Presidents, concerned, for approval.

To avoid being delayed by waiting for the approved copy to be returned, the Purchasing Department uses copy two in preparing to write the order. The price of the material is looked up by the price clerk, and entered on the requisition; or bids are secured and listed in the spaces provided on copy two. When the vendor is decided upon, his name is written in the space provided at the top of the sheet. Other information necessary for the purchase order typist is entered on this copy, also at the top of the sheet, so that it may all be seen at a glance.

When copy number one is returned after approval, it is attached to copy number two and at once turned over to the purchase order typist. There is thus no delay in placing an order, once it has reached the Purchasing Department after final approval.

Copy number three is retained by the department ordering the material, and space is provided on this copy for any record the department may wish to make. Each department is assigned a code letter or code letters and each person in the department who writes requisitions is assigned a number series. For example, the code letters for the Contract Department are CN,

1	REQUISITION ON PURCHASING DEPARTMENT NO _____ DATE _____ 19____			
TO PURCHASING DEPARTMENT				
THE FOLLOWING ARTICLES ARE REQUIRED FOR THE COMPANY				
TO BE CHARGED TO		ESTIMATED COST \$		
DELIVER TO		ADDRESS		
NECESSARY FOR				
SIGNED		APPROVED		
QUANTITY REQUIRED	ARTICLE GIVE COMPLETE DESCRIPTION	ON HAND	30 DAYS? REQUIREMENTS	WHEN WANTED
REQUISITION ON PURCHASING DEPT. <small>PREPARED BY BUREAU OF COMMERCIAL ECONOMICS INC SEPTEMBER 1921</small>				
APPROVED		HEAD OF DEPARTMENT		
APPROVED		VICE PRESIDENT OF ORIGINATING DEPT.		
APPROVED		PURCHASING AGENT		
APPROVED		VICE PRESIDENT IN CHARGE OF PURCHASING		
PURCHASE ORDER NO _____		DATE ORDERED _____		
FORM _____				

and since there are three members of this department who write requisitions, their numbers run in sequence from CN 1,000, CN 2,000, and CN 3,000. This enables the department to know at a glance who has written any requisition, and it enables the Purchasing Department to recognize easily the requisition of any department and of any person in that department.

Other features of the requisition here shown that are worthy of note are: the large numerals identifying each sheet, the careful organization of the sheets so that only that information which should be the same on all three sheets is written while the carbon is inserted, the specific information called for, the careful designation of the use of each sheet, the spaces on sheet number one to record the purchase order number and the date ordered, and finally, the size of the requisitions, 8" x 10", which cuts out of a standard sheet of paper with no waste.

REVERSE SIDE OF COPY 1 OF REQUISITION FORM

DATE INVOICE RECEIVED	AMOUNT OF INVOICE	QUANTITY BILLED

PURCHASE ORDER

PREPARED BY

BUREAU OF COMMERCIAL ECONOMICS, INC.

SEPTEMBER, 1921

NOTE

WILL NOT BE RESPONSIBLE FOR ANY GOODS DELIVERED WITHOUT PURCHASE ORDER. SEND SEPARATE INVOICE FOR EACH PURCHASE ORDER NUMBER.
DELIVER NO INVOICES TO EMPLOYEES.
WILL NOT PAY FOR BOXING, PACKING OR CARTAGE IF THIS PURCHASE ORDER IS NOT ACCEPTED EXACTLY AS WRITTEN. RETURN AT ONCE WITH EXPLANATION.

IT SHALL BE UNDERSTOOD THAT THE CASH DISCOUNT PERIOD WILL DATE FROM THE RECEIPT OF THE INVOICE AND NOT FROM THE DATE OF

IT IS A CONDITION OF THE ORDER AND BY FILLING IT YOU WILL BE DEEMED TO HAVE AGREED, THAT IN CASE ANY ARTICLE SOLD AND DELIVERED TO THIS COMPANY HEREUNDER SHALL BE PROTECTED BY ANY PATENT OR COPYRIGHT, YOU WILL INDEMNIFY AND SAVE HARMLESS THIS COMPANY FROM AND AGAINST ALL SUITS, CLAIMS, JUDGMENTS AND COSTS INSTITUTED OR RECOVERED AGAINST IT BY ANY PERSON OR PERSONS WHOMSOEVER ON ACCOUNT OF THE USE OR SALE OF SUCH ARTICLE BY THIS COMPANY IN VIOLATION OF RIGHTS UNDER SUCH PATENT OR COPYRIGHT

COMMONWEALTH EDISON COMPANY

2	REQUISITION ON PURCHASING DEPARTMENT NO.			DATE _____ 19____
ALWAYS SEND THIS COPY DIRECT TO PURCHASING DEPARTMENT				
THIS SPACE TO BE FILLED OUT BY PURCHASING DEPT				
ORDER FROM _____		RATE REQUIRED _____		
VIA _____ F.O.B. _____				
SPECIAL INSTRUCTIONS TO ORDER TYPIST _____		ESTIMATED COST \$ _____		
DELIVER TO _____ ADDRESS _____				
NECESSARY FOR _____		APPROVED _____		
QUANTITY REQUIRED	ARTICLE GIVE COMPLETE DESCRIPTION	ON HAND	30 DAYS REQUIREMENT	WHEN WANTED
REQUISITION ON PURCHASING DEPT.				
PREPARED BY BUREAU OF COMMERCIAL ECONOMICS (19) SEPTEMBER 1921				
FOR USE OF PURCHASING DEPT ONLY				
VENDOR	ADDRESS	UNIT	UNIT PRICE	DISCOUNT
FORM				

SIZE 8 x 10

56 PURCHASING PRINCIPLES AND PRACTICES

THE PURCHASE ORDER

The purchase order here shown is written in eight copies. It is printed in fanfold form, and by means of a special attachment feeds through the typewriter without necessitating the insertion of carbon sheets before each order is written. Moreover, one or more carbon sheets can be drawn out of position at any time so that information not desired on any one of the sheets may be omitted. With this arrangement, one typist can write more than two hundred purchase orders daily.

The purchase order is 7" x 8½" and is designed to cut out of a regular sized sheet of paper with no waste. The space for the

1 PURCHASING DEPARTMENT FILE COPY	COMMONWEALTH EDISON COMPANY EDISON BUILDING - 72 W ADAMS STREET	CHICAGO, _____ 152 _____
TYPED BY _____ CHECKED BY _____		NOTICE ON BILL OF LADING, SHIPPING MEMO, INVOICE (IN DUPLICATE), AND EVERY PACKAGE, PUT THIS PURCHASE ORDER
PACKAGES MUST BE MARKED WITH PURCHASE ORDER NUMBER		
SHIP TO VIA	ON OR BEFORE FOB	INVOICE RECEIVER _____ AMOUNT _____
QUANTITY AND DESCRIPTION		PRICE
PURCHASE ORDER. PREPARED BY BUREAU OF COMMERCIAL ECONOMIES, INC. SEPTEMBER 1921		
CHARGE TO ORDERED BY REQUISITION NUMBER FORM PO-1	BY PURCHASING AGENT BY COMMONWEALTH EDISON COMPANY BY SELLER HEREBY AGREES TO, AND SHALL BE BOUND BY THE TERMS AND CONDITIONS PRINTED ON THE BACK HEREOF	

Size 7" x 8½"

vendor's address is arranged to fit the regular window envelope of the Company, necessitating only one fold before insertion in the envelope. Each sheet is numbered plainly, facilitating distribution. Before being taken from the typewriter, the different sheets are automatically separated, the perforations at the edge where they are folded being slit with knives. This reduces the time necessary to distribute the purchase orders. While each of the above points seems minor in itself, yet in a large company the saving in time and money thus effected becomes very much worth while.

Copy number one is the Purchasing Department file copy. It is filed in a post binder, numerically, and is never removed for any purpose. When an invoice is received applying to it, the date and amount are entered in the spaces provided. If, however, several invoices are to be received, these are entered on the back of the purchase order in the space designed for this purpose. In case this space is not sufficient, another sheet, ruled in the same manner as the back of the purchase order, and of the same size as the purchase order form, is placed in the binder next to the original copy, and entries of further invoices are made here.

The information in the lower left-hand corner is not for the vendor, and the carbon between copies one and two is withdrawn

COMMONWEALTH EDISON COMPANY EDISON BUILDING - 72 WEST ADAMS STREET	
2	
CHICAGO, _____ 192_____	
<input type="checkbox"/> PACKAGES MUST BE MARKED WITH PURCHASE ORDER NUMBER	
<small>SHIP TO</small> <small>VIA</small>	<small>ON OR BEFORE</small> <small>FOB</small>
<small>QUANTITY AND DESCRIPTION</small> | <small>PRICE</small>	
<small>MAIL INVOICE IN DUPLICATE</small>	
<small>PURCHASE ORDER</small> <small>PREPARED BY</small> <small>BUREAU OF COMMERCIAL ECONOMICS, INC.</small> <small>SEPTEMBER 1921</small>	
<small>PLEASE ACKNOWLEDGE THIS PURCHASE ORDER BY RETURN MAIL AND GIVE DATE GOODS WILL BE SHIPPED DATE INVOICE (IN DUPLICATE), SHOPPING MEMO AND BILL OF LADING ON THE DAY OF ACTUAL SHIPMENT AND SEND TO 72 WEST ADAMS ST FORM P.D.1.</small>	
<small>BY _____ PURCHASING AGENT</small>	
<small>BY ACCEPTING AND FILLING THIS ORDER, OR ANY PART THEREOF, THE SELLER HEREBY AGREES TO, AND SHALL BE BOUND BY, THE TERMS AND CONDITIONS PRINTED ON THE BACK HEREOF.</small>	
<small>COMMONWEALTH EDISON COMPANY</small>	

before these spaces are filled. Definite responsibility for each purchase order is fixed by having the person typing and the persons checking initial each order in the spaces provided.

Copy two goes to the vendor. It is identical, as to printed terms and conditions, with the original. Copy three goes to the General Storekeeper. The information in the lower left hand corner is reproduced here, and spaces are provided in the right hand corner for the General Storekeeper's record.

Copy four is for the files of the department originating the requisition. Copy five is the receiving ticket. This copy, properly signed, accompanies the invoice to the auditor, and becomes a part of the voucher file. The purchase order is the same size as the voucher, making it possible to maintain an orderly appearing voucher file.

The sixth copy is used in the Purchasing Department, first to compile a daily record of the volume of purchases, second to record purchases in the purchase and cost record book, and third, to use as an acknowledgment file. The seventh copy is the tracer. Tracing is controlled by a semi-automatic tickler file. All purchase orders outstanding for one week without acknowledgment are traced by means of this copy. Copy number eight goes to the traffic clerk. Naturally, however, there are many orders in which the traffic clerk is not interested, since they may not involve out of town shipments. In this event, some other use is made of most of these copies. For example, the Sales Department gets the eighth copy on all material picked up from local manufacturers or jobbers.

REVERSE SIDE OF COPY 2 OF PURCHASE ORDER FORM

<p>NOTE</p> <p>YOU WILL NOT BE RESPONSIBLE FOR ANY GOODS DELIVERED WITHOUT PURCHASED ORDER.</p> <p>YOU WILL PAY IN ADVANCE FOR EACH PURCHASE CREDIT NUMBER.</p> <p>YOU WILL PAY IN ADVANCE.</p> <p>YOU WILL NOT PAY FOR BOX NO PACKING OR CARTAGE.</p> <p>IF THIS PURCHASE ORDER IS MADE A PART OF AN EXACTLY MATCHING PURCHASE ORDER WITH UPLANDER, IT WILL BE UNLTD. FOR 30 DAY'S PAY THE CASH DISCOUNT QUOTED ON THE PURCHASE ORDER AND PAY THE INVOICE AND TAX FROM THE DATE OF THE INVOICE.</p>	<p>IT IS A CONDITION OF THIS ORDER, AND BY FILLING IT YOU WILL BE REEMPTED TO HAVE AGREED THAT IN CASE ANY ARTICLE SOLD AND DELIVERED TO THIS COMPANY IS HELD AS INFRINGING OR SUSPECTED BY ANY PATENT OWNER OF ANY RIGHT, YOU WILL INDEMNIFY AND SAVE HARMLESS THE COMPANY FROM AND AGAINST ANY AND ALL SUITS, CLAIMS, JUDGMENTS AND COSTS WHICH MAY BE BROUGHT AGAINST THE COMPANY OR ITS AGENTS OR EMPLOYEES WHOEVER, ON ACCOUNT OF THE USE OR SALE OF SUCH ARTICLE OR IN ANY WAY IN VIOLATION OF RIGHTS UNDER SUCH PATENT OR COPYRIGHT.</p>
COMMONWEALTH EDISON COMPANY	

THE MECHANICS OF THE PROFESSION 59

3 THIS COPY FOR
GENERAL STOREKEEPER

CHICAGO _____ 192_____

PACKAGES MUST BE MARKED WITH PURCHASE ORDER NUMBER

PURCHASE ORDER

SHIP TO

ON OR BEFORE

VIA

FOB

QUANTITY AND DESCRIPTION

PRICE

PURCHASE ORDER

PREPARED BY
BUREAU OF COMMERCIAL ECONOMICS, INC.
SEPTEMBER 1921

CHARGE TO _____

DATE SHIPPED _____

ORDERED BY _____

DATE RECEIVED _____

REQUISITION
NUMBER
FORM 10-12

4 ORIGINATING DEPARTMENT
FILE COPY

CHICAGO. _____ 192_____

PACKAGES MUST BE MARKED WITH PURCHASE ORDER NUMBER

PURCHASE ORDER

SHIP TO

ON OR BEFORE

VIA

FOB

QUANTITY AND DESCRIPTION

PRICE

PURCHASE ORDER

PREPARED BY
BUREAU OF COMMERCIAL ECONOMICS, INC.
SEPTEMBER, 1921

CHARGE TO _____

RECEIVED BY _____ DATE _____ 192_____

ORDERED BY _____

APPROVED BY _____

REQUISITION
NUMBER
FORM 10-12

PER _____ HEAD OF DEPARTMENT

60 PURCHASING PRINCIPLES AND PRACTICES

5	RECEIVING TICKET THIS COPY TO GO TO THE RECEIVING CLERK OR TO THE PERSON WHO ACTUALLY RECEIVES THE MATERIAL	NOTICE UPON RECEIPT OF MATERIAL ENTER DUALITY IN DATE RECEIVED AND RETENTION PERIOD TO WHICH CLERK IN YOUR DEPARTMENT, FOR APPROVAL AND DISPOSITION. ADJUSTMENT NOTICE MUST BE SENT THROUGH FOR ANY SHORTAGE DAMAGE, OR RETURNED MATERIAL.	CHICAGO, _____-192-
PACKAGES MUST BE MARKED WITH PURCHASE ORDER NUMBER			
		PURCHASE ORDER	
SHIP TO		ON OR BEFORE	
VIA		FOB	
ENTER QUANTITY RECEIVED IN THIS COLUMN		QUANTITY AND DESCRIPTION	
<div style="text-align: center;"> PURCHASE ORDER PREPARED BY BUREAU OF COMMERCIAL ECONOMICS, INC. SEPTEMBER, 1921. </div>			
CHARGE TO _____		RECEIVED BY _____ DATE _____-192-	
ORDERED BY _____		APPROVED BY _____ HEAD OF DEPARTMENT	
REQUESTION NUMBER FORM DD-12		PER _____	

6	PURCHASING DEPARTMENT FILE COPY		
USE THIS COPY FOR MAKING DAILY REPORT AND FOR ENTRIES IN PURCHASE AND COST RECORD BOOK			
CHICAGO, _____-192-			
PACKAGES MUST BE MARKED WITH PURCHASE ORDER NUMBER			
		PURCHASE ORDER	
SHIP TO		ON OR BEFORE	
VIA		FOB	
QUANTITY AND DESCRIPTION		PRICE	
<div style="text-align: center;"> PURCHASE ORDER PREPARED BY BUREAU OF COMMERCIAL ECONOMICS, INC. SEPTEMBER, 1921. </div>			
CHARGE TO _____		ACKNOWLEDGED _____ TRACED _____	
ORDERED BY _____		PROMISE _____	
REQUESTION NUMBER FORM DD-12			

THE MECHANICS OF THE PROFESSION 61

7 TRACER

COMMONWEALTH EDISON COMPANY
EDISON BUILDING - 714 W ADAMS STREET
PURCHASING DEPARTMENT

THIS IS NOT AN ORDER

DATED 192

GENTLEMEN PLEASE REFER TO THIS PURCHASE ORDER NUMBER AND ADVISE AT ONCE WHEN SHIPMENT OR DELIVERY WILL BE MADE. WE HAVE RECEIVED NO INVOICE FOR THE FOLLOWING MATERIALS; IF SHIPPED ATTACH INVOICE IN DUPLICATE AND RETURN AT ONCE WITH THIS TRACER.

SIGNED CHARLES A HARDING
PURCHASING AGENT

PER PURCHASE ORDER

SHIP TO []
VIA []
ON OR BEFORE []
FOB []

QUANTITY AND DESCRIPTION | PRICE

PURCHASE ORDER
PREPARED BY
BUREAU OF COMMERCIAL ECONOMIES INC
SEPTEMBER 1926

REPLY

THIS IS NOT AN ORDER

8 PURCHASE ORDER
TO TRAFFIC DESK

The purchase and cost record sheet illustrated is made up from the purchase order. This sheet is designed for use in a visible index book, a feature which saves much time in compiling the record. This type of index has been found particularly adaptable to the needs of the Purchasing Department, and the Commonwealth Edison Company uses it for several purposes, such as for a file of vendor's addresses, a file of telephone numbers, and a file of vendor's discount terms.

PURCHASE AND COST RECORD SHEET

CHAPTER VII

MODERN CATALOGUES AND FILES

Many Varieties in Use.—There have been many discussions concerning the value of a modern catalogue file, and the best way to maintain it. There are nearly as many different kinds of catalogues and of catalogue files as there are individual purchasing agents. Somehow or other, few purchasing agents realize that a catalogue file is in reality only a small library, and that ordinary library filing methods may be easily applied. The various methods of filing frequently used are discussed in this chapter.

Vertical Files.—Many buyers who maintain rather a small catalogue library have adopted the plan of filing all catalogues and pamphlets alphabetically in vertical letter files. This works very well where the file is small, and the material consists mostly of pamphlets, and where the material is not used a great deal. For the average large file, however, more than half the catalogues are bound volumes which do not fit well in letter files. Moreover, their greater bulk makes this method of filing expensive. You would hardly expect to file an encyclopedia in vertical letter files.

Open Shelves Alphabetically Arranged.—Many other buyers file all material in open shelves alphabetically. This works well where the library consists of only a few hundred catalogues, but is hardly feasible where the file runs into several thousand books. Moreover, it is most difficult to keep a neat file of books and pamphlets together in an open shelf. The pamphlets and flexible bound volumes slip down and get pushed out of place, giving the whole file an untidy appearance.

In Open Shelves Numerically Arranged.—Another plan much in vogue is to number all catalogues with an automatic numbering machine as they arrive, and file all the material in open shelves. This method requires a finding list, or index, arranged alphabetically by firms or commodities, or both. This system makes it possible to find the catalogues more

easily, but the pamphlets still give trouble when filed with the bound volumes on open shelves.

According to Size.—You may build up a good looking and very usable file by arranging all catalogues according to size in sectional bookcases. In the index to this file each catalogue will be given a shelf number and a serial number. It is easy to pick out the volume you want if you know what shelf it is on. This file may also be cross-indexed by commodities, or you may find the names of the firms carrying certain commodities by referring to your commercial register, and then find the volume you want by referring to the alphabetical index.

A Combination Plan.—Perhaps the best all-round method of filing catalogues is numerically by groups. For instance, all catalogues dealing with machinery may be given numbers 1 to 100; and all pamphlets dealing with machinery, numbers P-1 to P-100; all catalogues dealing with furniture, numbers 101 to 200; and all furniture pamphlets, P-101 to P-200; all catalogues of electrical goods, numbers 201 to 300; and all electrical pamphlets P-201 to P-300, etc.

Under this plan, all pamphlets would be placed in a separate file or section. They may be filed in vertical letter files, or in pamphlet boxes according to number. When pamphlet boxes are used, all the pamphlet boxes bearing catalogues relating to machinery might rest on the open shelves next to the file of bound volumes describing machinery. Ordinary metal shelf dividers, such as are used in a library, may be used, and expansion space should be left after each class or group. This plan presupposes the use of an index. It offers the additional advantage of showing at a glance how much material you have on a given class of goods, and in what condition the file may be at any time.

Cross-Indexing Obviated.—This plan of grouping all the catalogues and reference books according to the general class of materials listed not only makes it possible to find quickly the certain catalogue needed from time to time, but it at once solves the vexing problem of cross-indexing the contents of your catalogue file by commodities. No cross-index can profitably be maintained for every item in the numerous volumes, and most cross-indexes sooner or later degenerate into a mere listing of groups or classes, so that the arrangement suggested serves as well as most workable cross-indexes. In addition, it is always up to date and reliable.

Few of us have made the intimate acquaintance of a catalogue file that always produced all the data required when needed but this filing system will, I am sure, approximate results as satisfactory as any other, and at a minimum maintenance cost.

An aid to the catalogue file often of infinitely greater value is the list of reliable sources of supply in the buyer's private loose-leaf book, under the headings of the various commodities. Some buyers attempt to build up such a list covering every item purchased. This piles up the cost for clerical work, and the file tends to become unwieldy. Most of us are content to maintain lists for two classes of purchases only: the expensive and important items and those which are rare, and not covered adequately by the various business directories. There seems to be little profit in attempting to duplicate in loose-leaf or card-record forms, the data contained in these directories.

CHAPTER VIII

RELATION TO OTHER DEPARTMENTS

The Production Department.—There have been many heated arguments concerning the proper relation between the production department and the purchasing department. The production manager argues that since he is responsible for maintaining production schedules, he should have jurisdiction and control over the purchasing department, because the failure of the purchasing department to supply his needs hampers production.

The purchasing agent argues that he is a capable executive and that his force is quite able to keep the production department supplied with everything it requires if the production manager will foresee his own needs. He argues that if the purchasing department were under the production manager, the necessity for foresight on the part of the production manager would be removed. This would result, he argues, in a flood of rush orders, and an expensive shortsighted buying policy. If all orders were to be submitted to the production manager for approval before being placed, the work of both would be delayed and hampered.

Another very real argument against making the purchasing department a subdivision of the production department is that, under this regime, you probably would have a lower grade man at the head of the purchasing department.

If there is any one place where the standard needs to be raised rather than lowered, it is in the purchasing profession. It is easier to understand many commercial catastrophes, and harder to understand many commercial successes when you consider the woeful lack of preparation, and the cramped working conditions of the purchasing agents of many of the large concerns.

Personnel an Important Factor.—In the practical working out of the relationship which should exist between the production and the purchasing departments, the final adjustment will depend pretty much upon the type of man you have

at the head of each department. Some capable purchasing agents will, perhaps, work better under a very capable production man, but most production men have troubles enough of their own, and have little time and few qualifications for the very specialized work of the purchasing department.

Relation to the Factory Superintendent.—The relation which the purchasing agent and his department will bear to the factory superintendent will depend entirely upon the organization and the lines of authority. If the factory superintendent is practically the general manager in active control of policies, as well as processes, there can be little objection to placing the purchasing department under his control. If, however, the policies of the business are fixed, and actually controlled by another executive, then the purchasing agent should report directly to him.

Relation to Credits.—Because the work of the credit manager and the work of the purchasing agent are alike, in that they are both always on the defensive, you might expect these two officers in any business house to be drawn together by a fellow feeling. Both have often deserved their reputations as gourmets. The value of both these men to their firms lies in their ability to say "no" at the right time.

Unfortunately both have too often failed to develop that rare ability to say "no" so that the other fellow will like it. It was said of the credit manager for one of the big Eastern jobbers that he could talk a customer out of a demand for more credit, talk him into paying a thousand dollars on his old account and make him like it. He never overplayed his hand, however, and did not refuse more credit when the request was justified.

Assistance Would Be Mutual.—The friendly attempt of the purchasing agent to understand and coöperate with the credit man would, no doubt, be of great assistance to both. Often the purchasing agent has at his finger-tips confidential information that would be of great value to the credit manager, but there is apparently neither occasion nor opportunity for the exchange of this information. Often the credit manager has information concerning the temporary embarrassment of vendor firms which could be of great help to the purchasing agent in negotiating new deals. In other words, if the purchasing agent were in a position to pay cash for a car of copper wire, and he should learn through the credit man that

one of the dealers was cramped for funds, he would be in a much stronger bargaining position. If he knew that Vendor B was financially unable to finance the fabrication of a large order he would place it with another firm. If he knew that the buyer for another firm was plunging on the commodity market, he should warn the credit man to watch that firm's account.

Cooperation Valuable to a Firm.—The continued interchange of this specialized information that both the credit manager and the purchasing agent possess would give their firm an advantage that is rare. This intelligent coöperation would make both of them more valuable to their firm than if they were to stand aloof and jealously guard their specialized information. Indeed, neither purchasing agent nor credit man has the right to deny to the firm the benefit of this information, which they have gathered while engaged upon their duties for the firm.

Every purchasing agent of experience and every credit manager will readily recall instances where they might have been saved much trouble and worry and where the firm either might have profited or have avoided loss if only they had coöperated. More and more both these officers must amplify the data they have on their card records and the information they receive through the agencies by the first-hand information gathered from the continued personal contact with men who direct the policies of the firms with whom they do business or may in the future do business.

Relation to Stores.—There have been many heated discussions concerning the proper relationship between the purchasing department and the stores department. Many production managers argue that because they are responsible for production, and production depends upon a continuous supply of the materials needed, the stores department should be under the production manager. They also argue that because they are dealing with the commodities at first hand, they are better fitted to determine stores' policies than the purchasing agent, who is essentially an office man.

This viewpoint is not without foundation in fact and there are many well managed plants where the stores department is under the production manager or the operating superintendent.

One Man Supremacy.—If, however, this line of argument be followed to its logical conclusion, you must place the pur-

chasing department under the production department, because the control of the stores department will not assure the continuous flow of the materials needed, unless the purchasing department provides them. Likewise, as the purchasing and stores departments cannot assure a continuous supply of needed materials unless funds are provided to pay for them, and the materials will do them no good unless the workmen are paid promptly, and so kept at their job, will it not be necessary to place the treasurer and the cashier under the production manager as well? If the production department cannot operate profitably unless the production manager has reliable cost figures why not give him the cost department, and the auditing department?

Pursue This Argument.—If you pursue this line of reasoning to its logical conclusion, your production man will become your general manager. To give the problem a little different quirk, why not place the production manager with his many newly acquired departments,—stores, purchasing, treasury, cashier, cost, and auditing,—under the sales manager? It will do no good to build up a sales force that can land orders if the goods are not forthcoming to fill the orders. To place the auditing department under the production manager is no more absurd than to give him control of stores. Yet you know of many well organized and well managed plants where that is done. There are at least two Chicago plants where the production manager has charge of both stores and purchasing.

Responsibility and Authority Inseparable.—The production department is like an army on the firing-line, and the purchasing department is the service of supplies. Can you picture any S. O. S. organization which could guarantee a continuous supply of needed materials without a stores division which it could control? When placed under the purchasing department, the stores department provides the much needed elasticity to the whole supply system. It is always poor policy to maintain an important department with a very small number of employees, because the incapacity of a single member of the force may seriously cripple the whole department. The addition of the stores department provides more workers of a type that will materially help to balance the work of the department. Much of the value of the purchasing agent depends upon his ability to take immediate advantage of attractive offerings. If the stores department is under the production

manager, the purchasing agent may logically be required to get his approval before any purchase can be made for the stores account.

Stores and Purchasing Are a Logical Unit.—Under this arrangement, the advantageous purchase must often be given up because of delay. Moreover, if the stores function is under the production department, the purchasing agent, in requesting requisitions for stock purchases which he regards as advantageous, will often be embarrassed not only by the delay of the requisition but by being required to convince the production manager of the wisdom of the purchase. In the average organization if you place the stores department under the production manager you might as well give him the purchasing department also and the next logical step would be to place the department in charge of a clerk because you cannot keep a competent purchasing agent if you give him no responsibility.

With the stores department under his control the purchasing agent may protect the interests of his concern by laying in reasonable stores of standard materials. The production manager in charge of stores, if he is unfriendly, may very easily embarrass and hamper the purchasing agent by making eleventh hour demands for materials which cannot be readily secured to advantage. While there are many good arguments on both sides of this question, and the best solution in any organization depends very largely upon the personnel involved, there is no reasonable doubt that, in the main, it is far better to place the stores department under the direction of the purchasing agent.

Relation to Auditing Department.—The relation which the purchasing agent and his staff will have to the accounting or auditing department will again depend very much upon the personnel. If accounting and purchasing departments are headed by competent men of broad experience, the line where the work of the purchasing agent leaves off and the work of the accounting department begins, will be adjusted by mutual consent. Generally speaking, since the heads of both these departments are or should be, experts in their particular kind of work, the less the duties of the two departments are permitted to overlap, the better.

Who Checks Invoices.—Where the accounting department is well directed and is in charge of an executive of broad experience and the purchasing department has not yet struck its

pace, it may be desirable to have the accounting department assume the details of matching and checking invoices against order copies. Where the accounting department is under-manned and the purchasing department is well organized and well directed, it might be well to have the vouchers made out in the purchasing department and forwarded to the accounting department for record. In the average well-balanced business house, however, neither of these practices is desirable.

Experience proves conclusively that the interests of all departments are best served when a clerk in the purchasing department matches the invoices and order copies, records the necessary invoice data on the order copy and passes the invoices—preferably accompanied by the office copy of the purchase order—to the purchasing agent or his assistant for certification for payment.

The clerk who prepares the invoice for certification will also indicate on the face of the invoice the account to which it is to be charged. Generally speaking, it is desirable to have the invoices all charged to stores accounts, and have the charges distributed in the accounting department by means of material charge tickets issued by stores. This method may require a little more clerical work, but it avoids the possibility of having goods charged to the operating accounts twice, or not charged to them at all. This confusion is always present when some invoices are handled one way and some another.

Accounts Payable Sheets.—All invoices should be listed on accounts payable sheets (see p. 109) before being sent to the accounting department for payment. One copy of this list should accompany the invoices, and the other copy should be retained by the purchasing agent as a record of the invoices passed for payment. This plan will furnish the means of avoiding the oft-repeated wrangle between these two departments as to where certain invoices are, and who may or may not have lost them.

As these invoices must all be listed in the accounting department on the accounts payable sheets, it is often possible to add enough distribution columns to the invoice lists so that these may serve the double purpose of invoice record for both departments, and voucher record sheets for the accounting department. A sample accounts payable sheet that has proved of service may be studied to advantage. (See Accounts Payable Sheet, page 109.)

Relation to Sales.—There is a wide divergence of opinion as to just what relationship should exist between the purchasing department and the sales force. Many purchasing agents of broad experience contend that they can best serve the interests of the firm only if the sales department and its activities are entirely disassociated from their work. No doubt this opinion is based upon sad experience. On the other hand, many progressive buyers of today feel that both departments benefit by the friendly coöperation of the two departments. The whole question hinges upon the use and abuse of reciprocity.

Advantages of Reciprocity.—Reciprocity is an excellent buying argument, but a poor selling argument. In brief, the purchasing agent who buys heavily from a given concern which could use more or less of the product of his house in turn, is not serving the best interests of all concerned if he does not bring this fact to the attention of the buyer in the other firm, and also of his own sales force.

Often the timely placing of a small order on his part will result in a much larger order for his house from the firm with whom he is doing business. If the sales manager will use the information collected by the purchasing agent, while being careful not to embarrass his relations with other houses in any way, he can multiply his own possibilities for profit, and thus increase his value to his firm.

This type of intelligent coöperation between purchase and sales departments is one more excellent illustration of the fact that it is vastly better to expend one's energies in lifting his fellows out of the mire than in attempting to push them farther under. That this type of coöperation is becoming more and more common is another proof that this old world is getting a little better each year.

The Purchasing Agent as a Director.—The purchasing agent is the business representative of his company in many important transactions. As such he should be a competent business man of broad experience in constant touch with his firm's policies, and the men who form them. There are many practical advantages in having the head of the purchasing department a stockholder, and a member of the board of directors.

The type of man who is today at the head of the purchasing department of large business corporations will render the same full measure of service, whether or not he receives a

share of the net returns from the business, but it is always desirable to have all departmental heads financially interested in the business. In any case there should be no great chasm between the board of directors, who represent the stockholders whose money is spent, and the man who does the spending.

CHAPTER IX

THE FUNCTION OF SPECIFICATIONS

A Fundamental Element of Success.—The very foundation of the successful conduct of a purchasing department rests upon right specifications. In the case of a manufacturing plant, there should be on file several complete sets of detailed specifications for each part or material to be purchased or fabricated. These specifications should be accompanied by blue prints and photographs whenever necessary.

The actual drafting of these specifications will be in the hands of the engineering or planning departments, but they should not be formally adopted until they have been carefully checked over by the purchasing agent. Many times the purchasing agent can suggest a minor change which will greatly reduce the cost, without in any way lowering the quality of the finished product. Indeed, it is often possible both to reduce the cost and increase the service of the finished product by the intelligent substitution of materials.

The progress of every successful purchasing agent is marked by many economies of this sort. For instance, the substitution of copper-sheathed steel cable for solid copper cable will greatly lower the cost, while in no way reducing the conductivity of electric cable. The substitution of enameled magnet wire for silk-covered magnet wire not only greatly reduces the cost, but for certain types of work, increases the insulation.

The Drafting of Specifications.—It should be the business of the purchasing agent to see that all specifications for his company are so drawn that the number of special items is reduced to the minimum, and the largest possible percentage of the materials specified may be secured in the local market. The advantages of being able to secure materials in the local market are many. Quite aside from the convenience, this enables the purchasing agent to reduce his own stock to the minimum. In fact it is often possible to make arrangements whereby the local vendors carry the stock. The mere saving of interest because of lessened investment in stock, added to

the potential loss through dead stock, will often amount to nearly as much as the net profit from all other operations. This is one means of adding to the net profit which has, in the past, been much neglected, but must be cultivated more carefully in the future.

In the times that are at hand the margin between profit and loss will, of necessity, be much narrower than it has been in the past. Many of the business houses which will survive the next decade will owe their very existence to the careful watching of such small economies.

Consult the Purchasing Agent.—It is just as absurd and extravagant to draw specifications without consulting the purchasing agent as it would be to plan a building without laying out the light conduits, or providing adequate cubical content for the persons it is designed to house. This is one good way to smother and blind your organization.

While the importance of buying by specification must not be under-estimated, it is quite possible for the purchasing agent to overreach himself in trying to force his own specifications upon the manufacturer. The other side of the purchasing of materials by specification may be briefly summed up as follows: Buying by specification like any other phase of regulation should be administered with a good deal of sane judgment.

Buying by Specification.—Theoretically, buying by specification is the most scientific and accurate method of buying any material. The purchaser desires a certain product for a certain purpose, specifies exactly the kind and quality of material required, secures quotations from several sources, and places the order with the lowest bidder. The only thing left is to inspect the material delivered, and pass the invoice on to the accounting department for payment. Theoretically, this method of purchase is not only beautifully perfect, but is automatic. You have merely to feed the specifications in at one end of the purchasing department, and the perfect materials are delivered at the other end.

Eliminating the Frills.—By this method you may also effect many economies, theoretically, at least. Your specifications are drawn so as to eliminate every item of expense that does not add to the real service of the product. You pay for no fancy labels, fancy finishes, or expensive containers. You eliminate expensive manufacturing processes which aid the general sale of a product, and appeal to the general public, with-

out adding any real value to the product. For instance, I understand that the stock from which a well-known soap is made is passed through huge beaters, under air pressure, in order that each particle of soap may absorb enough air to make it float readily and always. This process adds nothing to the cleansing value of the soap but adds greatly to its general popularity.

Unfortunately, however, buying by specification does not work out that way always. The practical difficulties are many and great in normal times, and under some conditions, are insuperable for the average purchaser.

Technical Skill Involved.—To begin with, in order to secure the right specifications, it is necessary to have each set of specifications drawn by a technical expert, who is also both a practical mechanic and a lawyer. These specifications must be revised for nearly every purchase, in order to keep them up-to-date and in accord with the best manufacturing practice, and you must have the services of an expert to test the material delivered. The real difficulty lies in the fact that the man who can draw specifications as they should be drawn is a very rare person, and when you do find him, his cost is often disproportionate to the size of the purchase.

Every manufacturer is a specialist in his line, and can afford to give you the regular product of his factory at a lower unit cost than the unit cost of an article specially made for one customer. If he does make a special product, you may depend upon it that he will tack on an extra profit to reimburse him for his trouble. In the long run, I believe that the man who buys by specially drawn specifications either pays more for the product he secures, or else finds that the specifications are so drawn that there is only one regular source of supply available, and so no competition for the business.

I believe that it is not only cheaper and easier, but vastly more satisfactory to all concerned, to make practical tests of a large number of standard products for a given purpose, select the two or three best brands for your purpose, and then buy the one which happens to be the cheapest at any particular time. These findings must, of course, be reviewed occasionally.

A Test of White Paint.—May I describe a practical test recently made on flat white paint? Twenty samples of different well-known brands were purchased in the open market.

A half pint of the contents of each can was completely broken up. Each half pint was then numbered and weighed and the number, weight, and brand were carefully recorded. We next painted a given surface of board with each sample, using a new brush for each sample. We then numbered the sample boards and recorded on the back the ease or difficulty of work, and the flowing quality. This data was then covered with a plain card, and the boards were shuffled and left for four days.

Next, the sample boards were smeared with soot, pencil marks, and grease, all of which was washed off. These sample boards were then sorted out by the process of elimination until we had the three samples which covered the best, flowed the best, were the whitest, and stood the washing the best. The label covers from these boards were finally removed and the names of the paints recorded. We now buy the one of these three which is cheapest.

I might add that the representatives of these paint concerns were first instructed that their dealings were with the purchasing agent alone, and that any salesman who made the acquaintance of the operating force would be dropped from the list. We have followed the above method of determining the product to be used wherever possible, and so far it works.

CHAPTER X

TESTING OF MATERIALS

The Importance of Tests.—It matters little who draws the specifications, or how accurately and scientifically they are drawn, if the materials are not kept up to the standards set by the careful testing of materials. The importance of the scientific testing of materials, like the scientific conduct of their purchase, is one of the phases of the work which is apt to be overlooked; or at best, underestimated. The reason for this is largely due to the fact that the results are all negative.

The testing or inspection department in the well organized industrial plant will seldom produce any great economies. The careful day-to-day inspection and check of all incoming material acts as a scientific check upon both the careless and the unscrupulous vendor. Because all small variations are caught and corrected there will be little opportunity to effect a large economy, but once permit the inspection department to relax its vigilance, and the waste from this source will at once begin to increase until it may threaten the very life of the organization.

Specific Cases.—The following excellent example of the cost of faulty or careless inspections will illustrate the point in mind. A Grand Rapids furniture factory brought out, in 1916, a handsome new lacquer finish, which was guaranteed to be both permanent and waterproof. The durability of the finish depended upon having the surface of the wood, and all the materials used, entirely free from oil.

A single shipment consisting of several barrels of stain used for undercoating was received, and put in stock without being inspected. This stain was all used, the furniture passed inspection, and several carloads were shipped to distant parts of the country. The oil in the stain began to work out and caused the lacquer to disintegrate. The result was that the manufacturer, in order to protect the reputation of his product, was obliged to bring this all back to the factory, remove all the defective finish, and refinish every piece. The cost of refinishing

ing added to the cost of freight and cartage both ways amounted to nearly as much as the first cost of the furniture.

The loss on this job would have paid for the maintenance of a competent inspection department several years, and would have saved the manufacturer much lost prestige. Yet that same inspection department, when properly running, would have great difficulty in proving economies which would add greatly to the net profits from operation. The profits from such departments are nearly always negative.

Inspection to Be Effective Must Be Continuous.—The testing and inspection of the finished product is just as important as the testing of the raw materials, as the following concrete instance will illustrate. In 1919, a public institution ordered fifty sets of dormitory furniture to be made to match samples submitted. The purchasing agent specified a certain number of coats of a high grade varnish for each piece. The furniture was inspected at the factory, and again upon delivery, and was duly accepted and paid for.

After about three months' service, however, many of the pieces began to turn white, and the chairs began to drop apart. A careful check back showed that there had been no adequate supervision in the finishing room, and that while a certain amount of the varnish specified was used, it had been used together with an inferior varnish. Some pieces were right on one side, or one end, and some were not right at all. The manufacturer was obliged to refinish the whole job in order to protect himself.

A careful check up on the chairs that were falling apart divulged the fact that the dowel holes were cut deeper than the length of the dowels, so that the hot glue all settled at the bottom, instead of being forced up around the dowels when they were driven in. Because of the lack of proper inspection, the dowels were not dipped in glue before they were driven in, the joints were almost without effective glue, and so the chairs began to drop apart. The whole lot of chairs had to be taken apart and rebuilt. The cost of correcting these errors amounted to nearly half the original cost of the new furniture.

Tests in Actual Practice.—Theoretically, every shipment of every item purchased for every purpose should be tested by the laboratory before the shipment is accepted and paid for. In actual practice, however, this process is far too expensive,

and far too slow. For instance, the Third Annual Report of the Purchasing Department of the State of California, published November 16, 1920, page 11, gives the average cost per test as \$6.21. Few business organizations would feel that they could assume such an expense.

Most successful manufacturing plants do, however, maintain a laboratory where all important items are tested, and a few do attempt to test every shipment of every item. The usual procedure is always to have the important items tested, and to test the less important items just often enough to keep the suppliers in line. Many small concerns who do not purchase enough material to warrant the maintenance of a laboratory depend upon reputable commercial laboratories for this service.

Inspection Department Relations.—Just what the relationship should be between the testing, or inspection department, and the purchasing department, depends very largely upon the personnel of the organization, and the general lines of authority. There is much to be said in favour of having the inspection department under the purchasing department. Generally speaking, however, the best interests of all will be served by having the inspections department under the production or operating department. Since that department is responsible for the production, it seems only fair to provide the means for checking the quality of the raw material furnished. This arrangement will also provide a means of checking the work of the purchasing department, and may serve to keep both departments on their toes.

CHAPTER XI

STORES EQUIPMENT AND FUNCTIONS

Items and Quantities.—In a previous chapter we have discussed at length the relationship which should exist between the purchasing department and the stores division. There remain to be considered the stores carried, stores records, the physical equipment of the stores department, and the functions of its workers. The first stores problem is the determination of items which should be carried in stock, and the quantities to be carried.

The Element of Distance.—If you are considering the stores department of a manufacturing plant, you will plan to carry in stock only those items of which a continuous supply cannot be assured by adjacent plants at reasonable cost. The factory producing brass castings which draws its brass from the brass mill next door, need carry no stock of brass pigs. If the brass mill is located across town, the storekeeper should perhaps carry enough stock to last two or three days. If the source of supply is out of town, the amount of brass to be carried will depend upon the distance and the dependability of the railroad service. If the raw material is drawn from an adjacent town connected by a direct railroad line with no switches intervening, perhaps a three day supply will be ample under normal conditions.

Piling Up Fixed Charges.—With the addition of each intervening switch, each junction, and each different railroad line between the factory and the source of supply of raw material, you must add to the amount of raw material to be carried in stock. Because of this, it is often more economical to pay a near-by source a somewhat higher unit price for the same material than you could afford to pay a distant vendor. When you insert the element of distance between your factory and its sources of supply, you are to that extent piling up fixed charges in the form of delay, uncertainty, interest charges, depreciation on stock, and handling charges.

All things else being equal, whenever you add another item to your stock list, whenever you add an unnecessary pound to the quantity of any material carried in stock, you thus add something to your total cost of doing business, and to just that extent you put your firm at a disadvantage in competing for new business and in holding old accounts.

To offset these losses incurred in storing and handling materials are the advantages of: (1) lessened unit cost, because of larger purchases; (2) possible appreciation in value, because of market changes; and (3) the assurance of a continued supply of raw material for the operation of the plant. As idle machines add so greatly and so rapidly to the overhead charges, and because idle machines mean dissatisfied customers, the investment of large sums in stocks of raw materials must be regarded as insurance against the greater losses from partial shutdowns. Insurance is advisable, but the stores department should make sure that the insurance does not cost more than it is worth.

Importance of the Physical Equipment.—Now that you have determined the items to be carried in stock, and the maximum and minimum amount of each to be carried, suitable storehouse room must be provided. The size and kind of buildings and the equipment required will vary greatly. Generally speaking, it is desirable to have the stores department on a single floor, and at the point in the plant which will make it possible for the material to be received and issued with the least possible waste effort.

The location of the stores facilities should be determined only after very careful study of the whole problem, and only after all interested persons have been consulted. In some highly competitive businesses the total net profit of certain individual plants is no greater than the stores loss in other plants, through careless planning and avoidable losses. In other words, under highly competitive business conditions, the economical operation of the stores department may be the determining factor in the struggle for existence of your plant.

Shelving for the Stores.—At least a part of the storehouse or storeroom must be provided with bins or shelving of some sort. The kind and arrangement will depend upon the material to be stored, with due consideration of the desirability of having the materials issued most frequently close to the issue counter, and those which are most valuable, and most likely

to be stolen, so placed that they may be adequately guarded with the least possible waste of time and motion. Perhaps the most desirable type of storeroom furniture is sectional steel shelving with adjustable shelves and dividers.

Vertical Bins for Heavy Parts.—Where the material stored is heavy and bulky, such as bolts, castings, and parts for automobile plants, a unique method of stores handling and stores control is sometimes used. In a certain automobile plant all material of this kind is stored in tiers of heavy tote boxes, which are piled one upon another by cranes.

These boxes are interchangeable, but each contains a certain number of each part. If each tote box will hold forty universal joints, and the tote boxes containing universal joints are piled ten high, the storekeeper knows he has 400 universal joints in stock.

If the minimum quantity to be carried is 120, the third box from the floor bears a red placard indicating the danger point. This sort of stores equipment makes it very easy to inventory, and to keep track of the stock, but would not lend itself to many types of stores materials.

Stores Records.—The sort of stores records kept will depend entirely upon the sort of business the store serves, and the personnel. For a manufacturing plant, a perpetual inventory of important items used is essential. This record may be kept either in the storeroom, in the purchasing department, or in the accounting department, as conditions and personnel may dictate, and it may be kept on cards, or in a ledger, either bound or loose-leaf.

Each method offers some advantages and some disadvantages. If your storeroom serves for maintenance only, and the stock varies widely and may be replenished quickly, the cost of maintaining a perpetual inventory is not warranted. The real test of a perpetual inventory system, as of any system, is, "does it pay its way?" Does this or that system provide you with certain facts in certain ways at certain times, so as to enable you to use these facts in a manner which will result in net savings? These net savings must, of course, offset the cost of producing the data, and leave a profit beside. If your record costs will not stand this test, they are of doubtful value.

A Guide to the Future.—The tabulation of facts concerning transactions which have passed is valuable only as a guide

to future conduct. The collection of data which is not used is an economic waste, and a needless burden upon your plant or institution. If the total cost of screws consumed per year is \$50, it will not pay to keep a perpetual inventory of these screws, if the total cost of keeping the record of these issues is \$20 per month.

If, however, the operation of your plant depends upon an adequate supply of those particular screws, and they are difficult to obtain, a careful record might be justified. Generally speaking, it will pay to purchase an extra quantity and put them in the vault for safe keeping, much as you may find it desirable to keep a gallon can of gasoline under the seat of your car.

Stores and Office Location.—Where the purchasing agent is responsible for the stores division, there are many advantages in having his office near the storeroom. This will mean that he will most certainly inspect the stores department frequently, and will keep in closer touch with the physical contents. If there is close contact, it may be necessary for him to protect himself against the interruption of his duties by members of the stores force.

Stock Keeping.—The general scheme of keeping items of stock should be not to make the shelves look full, and have every item brought to the front of the shelves and nicely aligned, but rather to have each size of every item pushed to the back of the shelves, piled as high as the shelves permit, and piled in even tiers. This method has the advantage of showing at a glance just how much of every item there is in stock. The even tiers greatly facilitate inventory.

Stock Balance.—Most accounting systems provide for a monthly balance, and permit the purchasing agent to know how much he has invested in stores at the end of each month. Even this data is often not available till well on into the next month, and is not adequate for the proper control of stores investment. The operation of the stores division is in this respect somewhat like the operation of a hotel. The hotel man long ago discovered that he must know each morning the net result of the operations of the day before. If he did not have accurate cost data daily, the sheriff would be tacking a placard on his front door before many months.

As the purchasing agent knows the balance at the end of the month, and all invoices go through his office, and as the

daily total of materials issued from the stores department can be readily obtained, he has at hand all the data needed. Let us assume that he is not supposed to have stores in excess of \$35,000, and that the balance on a given date was \$34,500.

Daily Record Easily Made.—I have a clerk note on a piece of journal paper the total of invoices charged to stores in one column, the total of material issued on material slips in the next column, and in the third and fourth columns the net increase or decrease as the case may be. The totals may be taken on an adding machine, and the whole record completed in less than ten minutes each day. This is an excellent means of control, and an excellent example of a bit of routine that does pay its way.

When the slump in commodity prices began in the autumn of 1920, a surprisingly large number of purchasing agents had only the scantiest information concerning the investment in stores materials. The buyer for a metal specialty manufacturing concern in Chicago was asked for a statement of the value of materials in stock, and estimated the amount at \$250,000. The actual inventory, when taken, showed \$185,000. The board of directors had authorized an investment of only \$150,000. The manager gave him 30 days to reduce his inventory, at a time when everyone else was trying to do the same thing. He could not unload, and his resignation was requested. The buyer for a phonograph manufacturing company with an authorized capital stock of \$250,000 was caught with \$180,000 tied up in raw materials, and he, too, was released.

The simple control method described above would have saved the day for both these men, and have kept their firms upon a dividend paying basis, instead of permitting them to tie up most of their resources in inventory. The really distressing feature of these episodes was that the executives lost sight of the fact that the purchasing agents who had been capable enough to see them through the rigors of war and reconstruction, were valuable assets, and especially valuable because of the added experiences they would have acquired while unloading surplus stock, and getting upon a safe and sane footing again.

CHAPTER XII

PURCHASE AND CARE OF OFFICE EQUIPMENT

Underlying Principles.—Let us now consider the underlying principles of the purchase of office supplies and equipment, and the care of these supplies after they have been delivered. There is, I find, an all too common belief on the part of office managers and their clerical assistants that the amount of money involved in these purchases is not large enough to warrant any scientific basis of selection, or any particular care of the material, after it has been purchased. This is an entirely wrong conception. The difference between right practice and wrong practice represents a considerable amount of money in a year, and the percentage of saving possible is often startling.

Pencils, etc.—Let us first examine in detail the various small items which will be purchased for the average office—pencils, pens, ink, carbon paper, pins, and clips. The total annual cost of pencils for any office is not huge, but it is highly desirable to select pencils that are suited to the requirements of the work, and then carefully to supervise the distribution. Pencils may be roughly divided into three classes: wooden lead pencils, paper pencils, and refillable pencils.

For general all around work the old style wooden pencil is best adapted. It should be furnished in two or three grades of hardness, and should be six or eight sided, so it will not roll off the desks. A pencil is usually used in making non-permanent records; therefore, it should be equipped with a fair quality eraser. The general objection to a paper pencil is its liability to break before it is used up, as many nervous office employees unconsciously put a good deal of pressure on their pencils.

Advantages Against Costs.—The third class of pencil is the refillable type, of which there are many kinds on the market. This type of pencil has the one great advantage of being always sharp, but it possesses three drawbacks: the cost is so high that issuance to the general office force re-

quires a considerable investment, and the general desirability of such a pencil for personal use makes its liability to disappearance high. Perhaps the greatest drawback to all such pencils lies in their excessive weight. Heavy pencils cause considerable fatigue after an hour's continuous use.

If there are in any special office conditions which make the use of refillable pencils, fountain pens, or other similar equipment desirable, the point may often be covered by offering to furnish these items for the clerical force at wholesale cost. Indeed, it may be found profitable to sell such equipment to the force for less than wholesale cost. This makes it easy for the office force to own these adjuncts to their work, and relieves the firm of initial investment, and the burden of caring for this petty equipment.

Pens and Inks.—The cost of pens is usually a small item unless fountain pens are used, in which case they may be supplied to the force at cost. It is not desirable to permit the use of fountain pens on valuable permanent records, such as ledgers and cash books, however, because of their liability to drop ink at inopportune moments. For certain types of work, the fountain pen is advantageous.

Ink is ordinarily purchased in quart bottles for office use, and where the point of ultimate consumption is near the point of manufacture, and the cost is reasonable, this is the most satisfactory form in which to purchase it. If, however, you are located in the country, or if the price is high, or breakage in transit is a considerable item, it is often best to purchase ink in either tablet or powder form, and have the office boy mix it.

This kind of ink is usually cheaper, can be more easily handled and stored, and is as good as the ready mixed ink. It has two distinct disadvantages—it is easily carried away by the office force, and the boy who mixes the ink must be closely watched, or he will make the ink so thick it will not flow, and will run the cost up to an unreasonable amount.

Carbon Papers.—The selection of a right carbon paper at a right price requires a great deal of tact, skill, and diplomacy. If you have a force of twenty stenographers, the probabilities are that they will have at least ten distinct preferences for different kinds of carbon paper. You may then pursue either one of two definite policies—you may give each one the kind of carbon paper she wants, and pay three

or four prices for it, or you may make an intelligent selection of the best available carbon paper, and supply it to all the force.

If you decide to use one carbon paper, do not use it a few weeks, and then try something else. Once you begin to drift about, you become legitimate prey for every carbon paper salesman, and you will spend more time talking to these salesmen than the whole purchase is worth. Select a good carbon paper for both pencil and typewriter, and then stay with that brand.

Buy Six Months' Supplies.—Permit me here to warn you against the purchase of carbon paper coupons. Statistics show that the average supply house can sell coupons for the carbon paper on a cost basis, and still make money, because of the large percentage of coupons that are never redeemed for some reason or another. Purchase a six months' supply of carbon paper twice a year, and refuse to discuss carbon papers with any salesman. A similar policy should be used in the selection of typewriter ribbons.

Checking Upon Waste.—Now that you have purchased these small supplies let us consider their issue and care. In the average office everyone gets all the supplies he asks for, but this is apt to be wasteful. In taking over the management of a new office, have all supplies inventoried and placed in a locked cupboard. For the first month, let the supply clerk issue all the supplies requested, and have him keep a record of the consumption. These issues for the first month should be checked over and quotas for every month fixed. Thereafter issues should be made only the first of each month, or semi-monthly. With occasional revision and adjustment you can easily control this one rather large expense item. Pins, clips, stenographic notebooks, scratch pads, and other small supplies, may be issued on the same basis.

Desks for Real Work.—Let us next consider office equipment, and then turn to the most important item of all—the printed form. I believe it is just as important to see that the clerks and stenographers have suitable chairs, desks, typewriters, and other similar equipment, as it is to see that your carpenters have suitable tools. Without proper equipment much of the energy is wasted in either case.

Experience shows that the best working desk is flat topped, because this type leaves little room for the accumulation of

papers and data that belong in the files. For the same reason the most useful typewriter desk is the type with the machine in the pedestal. This desk has three great advantages: It enables the stenographer to use the typewriter without moving all the papers on it; places all papers conveniently near at hand; and still farther cuts down storage space.

Chairs and Typewriters.—It is important that the chairs used by the office force be light, easily movable, adjustable in height and comfortable. Experience shows that a chair built with a perforated leather seat over cane is both serviceable and comfortable.

There is a rather wide range possible in the selection of a typewriter. There are many arguments in favor of the adoption of each one of the several standard models. You cannot go very far wrong, no matter which you select.

Methods of Buying Printing.—There are several different methods of buying printed forms in vogue today. Some firms select a trustworthy printer, and give him all their business. This method results in the prompt delivery of jobs, and in general satisfaction, if the purchaser regards stationery as a necessary evil, and a matter of too small importance to warrant serious consideration. In this class you usually find the moderate sized firm that is not very aggressive. Some firms follow the same system, but secure competition on an occasional job, in order to satisfy themselves that they are not being overcharged. When the printer is suddenly asked for a bid on a job for a firm that has been placing all its business without bids, he submits a price at cost, or under, gets the job, and then tacks a little extra profit on the next few jobs.

Some business concerns feel that the only solution of the printing problem lies in the operation of their own plants. The usual result is that their printing costs much more than when the other fellow did it.

Why the Cost Runs Up.—The printing plant operated by the average industrial concern runs up the cost of jobs because it is usually equipped to take care of the maximum requirements of the plant, and carries a heavy burden of unproductive time. This, added to the lack of the necessity for making a profit, and the temptation to squander time in experiments, greatly increases the net cost.

One large firm of packers has solved this difficulty by

installing a printing plant capable of turning out only 60 percent. of their estimated requirements. All jobs are figured by the printing foreman in competition with outside printers, with the result that the house plant does only the work that it can do most cheaply, and it always has a full schedule. Viewing this arrangement solely from the standpoint of the cheap production of a given job, it is highly satisfactory.

Some large consumers of printing let all printing jobs on open competition, with the result that the printer who forgets some item of cost in figuring the job gets the order and loses money. This results in a most unhealthful condition, and offers a premium for skimped work.

The Modern Method of Purchase.—The modern method of placing printing contracts is very different from all of these. The letting of contracts for printing under this plan is no haphazard makeshift, but the result of careful analysis of the needs and uses to which a given piece of printing is to be put. Every printed form is studied with seven things in mind:

1. Is this form necessary?
2. Can it be combined with other forms?
3. Is the size standard, 3 x 5, 4 x 6, etc?
4. If it is printed on two sides, is this necessary?
5. Would a rearrangement of copy serve the same purpose, and reduce the cost of setting?
6. Is the stock suited to the purpose for which the form is used?
7. If on coloured stock, is this necessary?

A careful study of one hundred forms used by the average business house will usually show that some records which need to be preserved for years are printed on stock containing ground wood, while others, which are preserved only a few days, are printed on linen ledger stock. You will find every size, weight, and colour of stock imaginable, varying in weight from thirteen to twenty-four pounds.

Forms, Standards and Weights.—The first step in the purchase of stationery, under the modern method, is to eliminate all unnecessary forms, and reduce the number by combining several forms. The next step is to reduce all forms to standard sizes and weights. This will enable you to print all the forms needed on six different kinds of stock, in

not more than seven colours, and perhaps four weights. Most of the forms can be run upon a 16-lb. all sulphide stock in white. As soon as you have determined the number of forms which can be run upon the 16-lb. all sulphide, the layout must be made up. Under present market conditions, the largest size stock sheet available in 16-lb. sulphide is the double folio, size 34 x 44, which will cut eight full sized letterheads or the equivalent.

Suppose for instance, that you need 5,000 each of four forms, size 8½ x 11, and 10,000 forms, size 11 x 17. You simply make two plates for the 11 x 17, and one plate for each of the other two forms, and run 5,000 impressions, then cut and pad. The same principle may be worked out with any number of small forms of different sizes, as long as the forms do not cut to waste, and all cut along straight lines.

Standardization Saves Money.—By standardizing the size, weight and colour of your forms, you make a huge saving. By running these forms in large sheets on a cylinder press, you make another large saving. A still farther saving may be made by designing your forms so that they may be produced with the least possible amount of composition. The charge for press work on two-colour forms is, of course, more than double the cost on single-colour forms. A form with a single ruled line costs nearly as much as a form with a dozen ruled lines. A form with uniform sized type is cheaper and easier to make up than a form set in several different sizes of type. In a word, the savings resulting from intelligently planning the purchase of all your stationery at one time, instead of just ordering a new supply of the individual items when your stock gets low, will amount to from 25 per cent. to 60 per cent.

Cutting Down on Forms.—The specifications of the printed forms used by the City of New York occupy a volume about the size of a telephone directory. A printer who received the contract one year, employed three estimators three weeks to figure the job. He then took the estimate which was highest, and added 25 per cent. as a safety margin. He was awarded the job, but lost money on his contract. The specifications for printing the same number of forms under the present plan would occupy considerably less than fifty pages, and could be safely figured by any printer in half a day.

By way of illustration, I submit the following brief report upon the printed forms used by a large educational institution in the East:

A STUDY OF THE PRINTED FORMS

December 19, 1918.

I have made a careful study of the printed forms in use by ten departments, and report as follows:

Total number of separate forms used per annum.....	252
Number of these forms printed on odd size stock (i.e. stock that cuts to waste).....	111
Number of standard size forms.....	141
Total number of separate forms used per annum.....	800,680
Estimated total cost per year—(10 departments).....	\$1,454.23
Number of forms plated.....	32
Number of forms printed on both sides.....	46
Number of different kinds of stock used was as follows: 9, 11, 14, 21, 8, 8, 10, 8, 31, 1..... Average.....	12

An examination of the forms indicates that the large number of odd sizes, and the wide variety of stock used are not the result of careful selection, but rather the natural result of the rapid expansion of the various departments.

The following recommendations, if adopted, would result in a saving of at least 20 percent. in the first cost of these printed forms, and would in many cases effect farther economies, because of standard forms and standard practice.

RECOMMENDATIONS:

1. That each department be requested to draw requisitions for a year's supply of printed forms; these requisitions to be drawn July 1st, and the finished job to be delivered in September. This will enable the press to do this work during the dull Summer months.
2. That as far as possible the stock be limited to:
 A—16 lb. all sulphide sheet.....for ordinary forms.
 B—20 lb. bond.....for forms to be preserved for files.
 C—Linen Ledger.....for official records.
 D—Cheap Bristol.....for placards.
 E—Medium Bristol.....for temporary card forms.
 F—Good grade Bristol.....for permanent records.
3. That each form bear a small stock number in the lower left hand corner, so that it may be easily duplicated.
4. That standard forms be plated.

The present method of handling each small job of printing as a separate unit of work is convenient, but expensive. If the bulk of the orders for printing were placed at one time, many of the forms could be run together on a single sheet, thus reducing the press work to a fraction of the present cost. Similar standardization by large commercial houses has effected savings varying from 25 percent. to 65 percent. I believe that we can save at least 20 percent.

Neglect of Printed Forms.—One reason why so little thought and attention have been devoted to the study of the scientific purchase of printed forms is that most business men consider them a very unimportant item of expense. Most

jobs are small, and they do not take the time to foot up the total amount expended. If purchasing agents would get into the habit of occasionally totaling the annual purchases of stationery, and other seemingly small items, they would often be astounded at the total amount of money involved. This sort of purchase has habitually been so neglected that it is easy to show percentages of saving that will amaze you.

Much of the scientific purchase of stationery today is due primarily to the published results of the studies of Russell A. Pettengill, of Chicago. The results achieved by him are most interesting and are contained in a series of articles in the "Purchasing Agent" beginning December, 1918.

CHAPTER XIII

BUDGET CONTROL OF PURCHASES BY DETAILED ESTIMATES

Advantages Great and Obvious.—Just as there does not seem to be any sound argument against the establishment of a centralized purchasing department, no matter what the size of the business, just so there does not seem to be any sound argument against the establishment of the budget or estimate system of control in any business. It is true that this method of controlling expenditures cannot be made to fit every business without individual variations in the system, to fit individual cases and particular problems. The advantages are so great and so obvious, and the objections are so groundless, however, that the reluctance of American business firms to adopt this method of control is hard to understand.

Spending money without regard to a definite plan of control, is like sailing without a chart. The business may make port safely, repeatedly, but sooner or later business currents will change, and the man without a chart will be in danger of shipwreck. Budgets may be made up for a year, for a quarter, for a month, or for a week; depending upon the conditions and the circumstances of the business. For most business concerns the best plan would be to make a quarterly budget, and then revise it monthly. In times of stress the budget should be reviewed and revised weekly.

Estimate Income First.—In making the budget the first step is to make a conservative estimate of the income for the budget period. The income data should be complete, and should show not only the gross amount of estimated income, but the sources from which it is expected, and the periods during which it is expected to be realized. This should be set up to show the income for this period, and the corresponding period for the last several years.

The next step is to budget the expenditures for the same period. The head of each department should be required to submit an estimate of the expenditures he expects to make

during that period. These estimates should not be made in lump sums, but should show the details, so that the auditor may draw up a statement to the best advantage.

The office manager will be required to show the number of employees in his department, together with their salaries for the period. He will be expected to show the amount he expects to spend for supplies, for vacation help, for new equipment, and for all other purposes in detail.

With this data in hand from all the departments, the auditor will then draw up a complete statement of the estimated expenditures for each department. This will at once show the manager of the company whether he is going to have enough funds to meet all obligations, or whether he must borrow.

If he finds he must borrow from the banks, the problem at once resolves itself into the question: "Is it better to borrow, or to curtail operations or expenses, or will it be better to do some of both."

Margins of Safety.—Let us assume the auditor estimates that the income from all sources for the next three months will be \$2,000,000 of which sum the sales manager estimates that sales will be \$1,500,000. If the cost of the raw materials in their particular product is about one-third of the selling price, then it is safe for the board of directors, or the general manager, acting for them, to authorize the purchase of \$500,000 worth of materials during the next quarter, assuming that the present inventory will not change materially.

Let us assume, however, that the sales manager has overestimated sales, and at the end of the first month in that quarter he has sold, not \$500,000 (one third of \$1,500,000) worth of goods, but only \$300,000 worth.

The board of control, or the general manager, will at once instruct the purchasing agent to cut down his purchases accordingly.

If Business Increases.—Let us assume, on the other hand, that there is a great increase in the volume of business, and that the factory is getting behind in its orders. It will then be up to the general manager to decide whether he will let the orders pile up, whether he will put on more workers, or whether he will first put it up to the production manager, to devise methods of increasing the output without increasing the working force.

Eliminating Guesswork.—In a word, buying by budget, or running a business on the budget method, is nothing more nor less than the careful tabulation in detail of the things that have been accomplished in the past, together with the amount that these accomplishments have cost, side by side with a conservative estimate of the things you expect to accomplish in the immediate future, together with a careful estimate of the amount of money you expect each item to cost.

With that sort of a chart before him, the modern manager can compare his actual progress with his expected progress, and his costs with his anticipated costs, as he goes along. This will enable him to correct dangerous tendencies before they get beyond control.

Budget System Not Inflexible.—Some individuals who have never had any experience running a business according to a budget, believe that a budget system is necessarily inflexible, and cannot accommodate itself to rapidly changing conditions. It is true that the more rapidly conditions change, the shorter should be the budget period, and the more frequently should the various items be reviewed.

But the manager who goes it blind without reference to a definite program of income and expenditures will, sooner or later, get into deep water. If no definite program has been mapped out, and expenses must be cut suddenly, the whole organization is apt to be thrown out of adjustment. The purchasing agent who serves a business firm that does not budget its income and its expenditures, is apt to find himself looking for a new connection, just when new connections are hardest to find.

Avoidable Overbuying.—Two very good examples of what may happen to a business run without a definite program have just come to my attention. During the war many of the smaller business concerns grew very rapidly and a good many purchasing agents were taken on who had rather limited preparation for that sort of work. The buyer for a metal goods concern was a very clever chap, with limited experience. The new business boom kept him so busy that he had no opportunity to work out a definite purchase policy. His firm had nothing which even approached a budget. There was no sales quota and no limit on raw materials stocks—in other words, practically no check on expenditures.

The purchasing agent was expected always to have on hand the material needed, and was blamed only if he failed in that. New business was coming in so fast that there was no thought of the constantly increasing inventory balance.

Business tightened up, almost over night, and the board of directors called upon the general manager for a statement of affairs. After working and sweating for weeks, he found that there was nearly half a million dollars in raw materials, and that the investment was not only more than three times as large as it should have been, but that the stock was badly assorted. The situation became so strained that the purchasing agent was forced to resign, and the business is now in financial difficulties.

Forced Sales at a Sacrifice.—The other instance is somewhat similar. The purchasing agent for a talking machine manufacturer was inexperienced. The firm was capitalized at \$250,000. Business had been very good, and practically all profits had been tied up in a new factory building.

When the period of business depression hit them, they found that they had \$180,000 tied up in inventory, much of which was later sold for less than half the cost. These instances with variations, could be multiplied indefinitely. No doubt many business houses would, however, repeat their errors if the same inflated conditions were to recur.

Self-protection a Duty.—The tactful purchasing agent who is connected with a business that does not budget its income, its sales, and its expenditures for materials, salaries, and other items, owes it to himself, his career, and his family, to see that he is provided with the means of knowing just what materials will be needed in the immediate future, and in just what quantities. He will see that his inventory is in such condition that the management will not be embarrassed, no matter what turn the market takes.

One must, of course, recognize the peculiar requirements of every business in drawing up a budget. The budget for a foundry would hardly fit the requirements for a flour mill, and the budget for an automobile plant would hardly fit the requirements of a furniture plant. Each has more or less seasonal and other variables that must be reckoned with; but the basic principle of budgeting is sound, and if adopted, will result in the salvation of many business houses.

Bibliography of Budgets.—For the student who wishes to pursue the subject of buying by budget farther, I suggest the following works:

1. AGGER, EUGENE E., "The Budget in the American Commonwealth."
2. BARTHELEMY, A., "Du Contrôle préventif des finances publiques."
3. LOWRIE, SELDEN GALE, "The Budget."
4. STOURM, RENÉ, "The Budget." Translation from "Cours des Finances," Paris, 1913.

University of Chicago Budget.—The method of controlling the purchases at the University of Chicago will be related in detail as an illustration of the practical operation of budget control as applied to an institution.

The fiscal year ends on the last day of June. In January, the auditor asks the head of each department for an estimate of the expenses he expects to incur during the next fiscal year. These estimates must not be in bulk, but must show in considerable detail salaries and the various other expense items, and the amount of money the department head thinks he should have for each.

In practice, the majority of department heads prepare tentative lists of proposed expenses, and then discuss each list informally with the auditor before formal recommendations are submitted in writing.

The auditor meantime prepares a detailed estimate of the income for the next fiscal year. All these items are tabulated, together with comparative figures from the last budget. After all these items are in, the auditor draws up a tentative budget which is submitted to the budget committee of the board of trustees for their approval. There again, the general plan is to discuss the tentative budget informally before the formal budget is submitted to the board of trustees. The reason back of these informal conferences is a desire to get the point of view of the department making the request. If the request is denied it is owing to one of two causes: (a) Because the request is not in accord with the policy of the University; (b) While it might be in accord with the policy there might not be sufficient funds to care for it.

Merely a Detailed Estimate.—After the budget has been drawn up and approved, it does not follow that the various departmental heads can at once proceed to incur the expense

items in the budget. The budget is considered merely as an estimate in detail of the amount that will be needed for various purposes during the next fiscal year. All increases in the pay-roll for the non-instruction staff items must be approved by the committee on expenditures before they become operative.

This committee on expenditures is made up of the chairman of the board of trustees, the president, the business manager, the auditor, and the secretary of the board of trustees.

Purchasing Materials.—When any department needs materials, the head of the department sends to the purchasing agent a requisition in triplicate. The purchasing agent fills in the estimated amount, certifies all three copies, and sends them to the committee on expenditures.

The purchasing agent, acting for the committee on expenditures, personally investigates all requests for materials which are not strictly routine, and endorses on the requisition a statement concerning the necessity or desirability of the incurring of expense. If the committee on expenditures should for any reason refuse to approve a requisition, the department head could, if he desired, present his case to the committee, either in writing or in person.

Theory and Practice.—In theory, all requisitions are held until the weekly meeting of the committee. Actually, the great bulk of requisitions are passed by the auditor and the secretary of the board of trustees, acting for the committee on expenditures. When a given requisition has been approved by the committee on expenditures, each of the three copies is numbered, and the estimated amount of the requisition is entered as a memorandum charge against the funds which have been set aside for the use of that particular department.

In this way the departmental appropriation is mortgaged for the estimated amount of the purchase, or other expenditure, before the expense is incurred. The original copy of the requisition is retained by the auditor, the duplicate goes to the purchasing agent as his authority to incur the expense, and the triplicate copy goes to the department head.

Unused Balances Cancelled.—Theoretically, the receipt of the duplicate copy of the requisition by the purchasing agent is equivalent to the notification that he has at his disposal the amount of money specified for the use of that particular department, but for the purpose specified, and for

no other. Any unused balances must be cancelled. If the purchasing agent receives an approved requisition authorizing him to buy a new steam sterilizer for \$300, and he succeeds in purchasing one for \$250, he cannot spend the other \$50 saved for a media rack. The other \$50 must be cancelled, and the requisition must be included in his next monthly statement to the auditor of requisitions, to be cancelled.

Blanket Requisitions for Routine Purchases.—As a matter of fact, all routine purchases are covered by blanket requisitions, drawn for the purchase of "miscellaneous items" up to a given amount. All petty cash disbursements are covered by special requisitions, as are all materials drawn from the various store rooms.

After the purchasing agent has received the approved requisition, the purchasing routine is not very different from that in any business concern, with the single exception that, when a purchase order is issued against a requisition, the number of the purchase order is noted on the face of the requisition, together with the amount of the purchase. In this way the appropriation is mortgaged by the requisition when the committee authorizes the purchase, and the requisition is mortgaged when the purchase order is issued. Thus it is impossible for any department to spend more than the sum set aside for its requirements.

Control of Stock Purchases.—When materials are purchased for stock, they are purchased without the specific approval of the committee on expenditures, and the amounts and the times of purchase are controlled by the purchasing agent, in consultation with the store keepers. When this material is drawn out by the various departments, it at once becomes a charge against a requisition. The only limitation on purchases for stock is the total amount of the investment, which is fixed by the board of trustees.

The Routine Outlined.—The purchasing routine is covered by the following outline. The purchases of the University of Chicago are of six distinct classes as follows:

- I. Departmental, i.e. delivered and billed out to the department
- II. For stock
- III. For resale
- IV. Foods
- V. Real estate maintenance; apartment and residence property
- VI. City buildings; i.e., office buildings

1. Departmental purchases.

A. An appropriation is made in January for the requirements of each department for the fiscal year, July 1st to June 30th.

B. Requisition. (See Form at end of chapter.) This is drawn by the head of the department in triplicate, and forwarded to the purchasing agent, who certifies as to the correctness of the amount, and sends it to the committee on expenditures. When approved and numbered, one copy goes to the purchasing agent as his authority to incur the expense, one copy goes to the department concerned, and one copy is retained by the auditor. Requisitions may be either for specific purchases or for miscellaneous purchases up to a given amount.

C. Request to purchase. (See Form at end of chapter.)
(1) This comes to the purchasing agent from the department giving the details of the purchase requested. (2) We encourage the department to give detailed information as to the possible price and source of supply. (3) The department keeps a carbon copy of the request to purchase for reference. (4) We accept many orders over the telephone for which no written request is made. (5) The purchasing agent personally routes and initials every order before it is placed, using the following abbreviations:

a P.—i.e., get written quotations from firms indicated. (See Form at end of chapter.)

b P.&P.—i.e., get telephone quotation from firm indicated, and if price is right, place the order.

c P.P.—i.e., send the order to the firm indicated, with a request that they telephone their quotation before filling the order.

d P.L.—i.e., place the order as indicated, using the price on your price-list.

(6) All quotations, blue prints, samples (if small), correspondence, and other data concerning a given purchase are attached to the back of the requests to purchase, which are filed vertically, under the number of the purchase order. This number is written in the upper right hand corner at the time the order is written.

D. The purchase order is written in quadruplicate. (See Form at end of chapter.) (1) Original goes to the vendor.

- (2) Duplicate is placed numerically in the unfilled order file, and when completed, goes to the filled order file (vertical), and is later transferred to a binder. All files are vertical.
- (3) Triplicate is a receiving slip which goes to the department that is to receive the goods. This is signed and returned to the purchasing agent's office as his authority to pass the bill.
- (4) The quadruplicate is sent to the department at the end of the month as a detail of the statement of purchases for the month.

a The price of each item is shown on all copies of the order in nearly every instance. Confidential price arrangements are, of course, not shown.

b Extra blank receiving slips are furnished the departments for use on back orders.

c Theoretically, no bill is passed for payment until some responsible person has acknowledged receipt of the goods. Actually, many bills are paid before the goods are received, in order to secure cash discounts. This practice has never yet caused any loss. When the invoice has been paid before the receipt is turned in, the duplicate and the quadruplicate copies are held in a pending file until the receipt arrives.

E. A careful monthly record is kept of the cash discounts taken, invoices certified, and of any discounts lost.

F. Because of the perishable nature of many of our purchases, a large number of shipments are delivered directly to the department, instead of being received at some central station. (1) This applies especially to inflammables, explosives, and delicate scientific apparatus. (2) The quadruplicate order copy goes to the requisition clerk, who notes the amount of the purchase on the requisition as an outstanding order, to prevent an overdraft, and is then placed in the tracing file, not by date, but by department.

a As most of our purchases are made in Chicago for immediate shipment, we use the tracing file very little.

b A weekly survey of the unfilled orders is sufficient.

c Copies of orders requiring special attention are kept on the desk of the chief clerk for daily check.

G. Order Index. (See Form at end of chapter.) Every order issued is indexed the morning after it is made. (1)

This card gives the firm name, address, telephone number, name of the man who handles our account, line of goods handled, and the number of the catalogue. (2) We number our catalogues from 1 up, regardless of size. If the catalogue is big enough to stand up, it goes on the book shelves; if it is too small for that, it goes in a pamphlet box. (3) See chapter No. VII for details of filing catalogues.

H. Checking invoices. (1) All extensions are checked on the comptometer as soon as the invoices are received. (2) The two office copies of the order, and the signed receipt, are held together on a spring clip bill board; carbons are inserted, and the unit price, discounts, totals, date, and amount of the invoice are filled in.

a Invoice is stamped and initialed.

b The order copies accompanying the invoice go to the purchasing agent for final approval for payment. This makes a huge pile of papers every day, but the whole history of the transaction is at hand when the bills are certified.

c All invoices are listed on long sheets and sent to the auditor for payment at the end of each month. Discount bills are, of course, sent up daily. (See Form at end of chapter.)

I. Price Listing. (See Form "Purchasing Record Card" at end of chapter.) In normal times all purchases are listed on a subject card index.

J. Requisitioning. (See Form at end of chapter.) The triplicate and quadruplicate order copies which are now practically copies of the invoice go to the requisition clerk, who transfers the order from the outstanding list to the completed list on the requisition blank. This double requisitioning of orders may seem unnecessary, but it forms an air-tight check upon the tendency of any department to exceed its appropriation.

K. Every thirty days we send each department a statement of the purchases made during the past month. (See Form "Statement of Account," at end of chapter.) This is merely a summary showing the order number, the requisition number, and the amount. This is accompanied by the quadruplicate order copies which give the details of the transaction.

(1) A summary of the billing is sent to the auditor from

which he charges the department and credits the purchasing agent's stores account.

a This billing also includes laboratory storeroom charges which are made out in triplicate in the store-room.

2. Purchases for stock differ from departmental purchases in the following respects:

A. Requests to purchase are made by head store-keepers, who are under the direction of the purchasing agent. Many stock purchases originate in the purchasing agent's office.

B. No requisitions are required, the only limitations being the total investment in stock.

C. As soon as invoices are checked, the quadruplicate order copy is sent to the stores department from which prices are taken for daily charges. These storeroom charge slips are made out in triplicate, showing quantity, price, and totals.

D. Stock purchases are not billed, but invoices are charged direct to the stores account from the distribution sheet.

3. Purchases for resale.

A. Because most of the purchases for resale are books and standard stationery items, a price list card is used as a request to purchase. This same card is used over and over again. When the book stock clerk wants to purchase a title, he locates the card which is filed under the name of the author, notes the number of books required, and gives it to the order clerk to have the purchase completed and recorded.

4. Foods.

All food stuffs for the eight dining-rooms are selected by the head of the commissary department, who is held responsible for these purchases.

5. Real estate maintenance.

These consist largely of coal and building materials for repairs. The invoices for these purchases are charged to the specific building by the auditor. Otherwise, these purchases are handled like stock purchases.

6. City office buildings maintenance.

The purchases for the office buildings are handled exactly like those of the real estate department, but are of a somewhat different class of materials.

The University of Chicago

THE COMMITTEE ON EXPENDITURES

Please authorize the **{** **Auditor**
Purchasing
Superintendent
University **}** **University**

Chicago _____ 192 _____ Charge to appropriation for

Chicago 192

Please authorize the to enter the following order:
Auditor
Purchasing Agent
Superintendent of Buildings and Grounds
University Bookstore
University Press

PLEASE DETACH SHEET ONLY AT THE PUNCTUATION

BUDGET CONTROL

	COST	Actual
	Estimated	
Note. The original is printed on white stock, the duplicate on pink, and the triplicate on yellow. The form is the same on all.		
Ed.		
Approved by _____ Approved by Committee on Expenditures	Director Dean of Faculties Business Manager	Secretary
This requisition is not effective unless approved by the Committee on Expenditures.	The University of Chicago By _____	Certified for - - - - - \$ _____ Department _____
		Purchasing Agent Supplementary Building and Grounds For the Bookstore For the Press
		19 —
		"REQUISITION" FORM

Purchasing Agent, Room 2, Press Building.		Please order the following items for the Department of _____		charging same to Requisition No. _____	
No. _____	Date wanted _____	Signed _____	Approved _____	Quotations from _____	
Estimate No. _____	Deliver to _____	ARTICLE	Cost of Article	REMARKS	
FIRM	Quantity	Unit of Measure		Date	Purchasing Agent
Ordered from					
Ordered by phone					
Ordered by					

NOTE.—A SEPARATE SHEET MUST BE MADE OUT FOR EACH CLASS OF GOODS AND SENT TO THE OFFICE OF THE PURCHASING AGENT
PLEASE AVOID RUSH ORDERS
ALL SUPPLIES AND MATERIALS MUST BE ORDERED THROUGH THE OFFICE OF THE PURCHASING AGENT

University of Chicago

Office of the Purchasing Agent
CHICAGO

Date

ORDER BLANK
ORIGINAL

Please furnish on account the following articles. SEND BILLS TO THE UNDERSIGNED as soon as material is forwarded. This order is subject to prevailing cash discount if paid on or before the tenth day of the month following purchase, and must be free of delivery charges. Advise us if you are unable to fill any part of this order. Bills must bear our order number.

QUANTITY	DEPT	REQ	PRICE		

The University of Chicago

Office of the Purchasing Agent
CHICAGO

Date

Order No. A _____
Put above number on your invoice
and on every package.

ORDER BLANK
DUPLICATE

Please furnish on account the following articles. SEND BILLS TO THE UNDERSIGNED as soon as material is forwarded. This order is subject to prevailing cash discount if paid on or before the tenth day of the month following purchase, and must be free of delivery charges. Advise us if you are unable to fill any part of this order. Bills must bear our order number.

QUANTITY	DEPT	REQ	PRICE		

The University of Chicago

Office of the Purchasing Agent
CHICAGO

Date

ORDER BLANK
TRIPPLICATE

This receipt must be signed and returned to the office of the Purchasing Agent, Room 2, Press Building, IMMEDIATELY UPON RECEIPT OF THE GOODS ORDERED.

QUANTITY	DEPT	REQ	PRICE		

The University of Chicago

Office of the Purchasing Agent
CHICAGO

Date

ORDER BLANK
QUADRUPPLICATE

This copy is intended as a permanent record of the goods ordered by your department. Please place this in your files for reference.

QUANTITY	DEPT.	REQ.	PRICE		

Deliver to

The University of Chicago

By _____
Purchasing Agent

“PURCHASE ORDER” FORM

The University of Chicago
Office of the Purchasing Agent
CHICAGO

REQUEST FOR QUOTATIONS

Inquiry for Dept.

Date

Please quote price on material as listed below delivered at the University. Submit quotation on this form, placing price opposite items listed. The right is reserved to accept or reject all or part of proposal submitted.

Article	If unable to furnish material as specified, list substitution	List	Discount	Net

NOTE: This is not an order

Signature of firm here

"REQUEST FOR QUOTATIONS" FORM

FTR IN _____

CATALOGUE NO. _____

ADDRESS

GOODS HANDLED—

PHONE

SALESMAN

The University of Chicago
Office of the Purchasing Agent
ACCOUNTS PAYABLE

Month ending -

Sheet No. _____

Continued From Rear

"ACCOUNTS PAYABLE" FORM

"PURCHASING RECORD" CARD

217

NP

The University of Chicago
Office of the Purchasing Agent
LABORATORY SUPPLY STORES

STATEMENT OF ACCOUNT

Date

"STATEMENT OF ACCOUNT" FORM

CHAPTER XIV

PROBLEMS IN PURCHASING LUMBER

A Problem That Is Different.—The purchasing agent who buys large quantities of lumber has a problem that is just a little different from that connected with the scientific purchase of any other commodity. Lumber is like coal in that it is not a manufactured article, and you never get two shipments exactly alike. The cheapest and best lumber for a given purpose in Chicago might not be at all economical for the same purpose in New York. Moreover, the factors which determine the right lumber to use for a given purpose change, not only with the locality, but change from season to season, and sometimes within the season.

There have been combinations of circumstances which made it economical to use mahogany logs for railroad ties. Sometimes it is economical to import ties, and sometimes it is economical to use domestic ties. After the armistice was signed, short lengths of walnut timbers designed for the manufacture of gunstocks were a drug on the market, and were used as bases for heavy machinery. In ordinary times it would be the grossest extravagance to use selected walnut for that purpose.

Only an Expert Can Beat the Game.—There are so many different grades of lumber, the different grades shade off into one another so imperceptibly, and the grading rules vary so widely in different parts of the country, that the purchasing agent who is not a lumber expert has little chance to beat the game, if he goes it alone. The one and only way to be sure that you are getting the most value for the dollars you are spending, is to make the acquaintance of two or three old lumber salesmen, and rely upon their suggestions and advice. If you treat them fairly, they will treat you fairly, and by using the friendly services of several of them you can use the advice and information of one to check the advice and information of the other, and so you cannot go far wrong.

If you blindly follow the lumber specifications given you by your production department without giving the salesmen a

chance to make suggestions, you will miss many opportunities for economies. For instance, it is a common practice among carpenter foremen to specify sixteen foot lengths. Many of these sixteen foot lengths are actually cut to eight foot and less when used. You can effect a considerable saving by ordering the same number of board feet in eight foot lengths. Many foremen specify lumber much wider than they really need. Often it is cheaper and better to buy lumber in shorter, narrower pieces than those originally specified.

Care in Changing Specifications.—It goes without saying that the inexperienced purchasing agent should be very sure that he knows what he is doing when he changes specifications. He should be very sure that the lumber he is specifying, and the lumber he receives is identical; and very sure that the men who have to use the lumber, and the men who are responsible for the quality of the finished product are in sympathy with the changes he makes.

The United States produces lumber from more than 500 varieties of trees. Moreover, the value of the lumber from a tree of a given species depends not only upon the supply and demand for that particular kind of lumber, but also upon the region in which that particular tree was grown, and the direction and strength of the winds in that locality, the thickness of the forest, and the amount of moisture in the soil from which it sprang.

When a tree grows in a thick forest, it has a long straight trunk, and the few lower branches it does have soon die for lack of light, and drop off. This leaves a clean, straight bole, but when the wound left by the falling branch does not quite close up, this defect shows up as loose knots in the finished lumber.

Hardships Toughen Trees.—When a tree lives under ideal growing conditions, the amount of growth it attains each year is much greater than that of a tree growing under adverse conditions. The wood produced by trees that live under ideal conditions is softer, and possesses much less tensile strength, and is capable of withstanding much less mechanical wear under service.

In other words, in specifying dense yellow pine, you are specifying not only the species from which you wish the lumber to come, but you are specifying the conditions under which the lumber must have grown.

Commercial timbers are divided into two general classes: hard woods and soft woods. This division is merely a matter of custom, and is not based upon the actual hardness or softness of the wood fibre. While the line is not closely drawn, it is true that the majority of the woods classed as hard woods are harder than the majority of those classed as soft woods.

Hard and Soft Groups.—In the soft wood group we find the pines, hemlocks, firs, spruces, and a few minor varieties. These are known as the needle leaf varieties, and most of them belong to the evergreens.

There are a great many varieties of hard woods, but in general all broad leaf trees are classified as hard woods. The principal commercial hard woods are oak, hickory, birch, beech, and walnut. Soft woods are used mostly for structural purposes, and the hard woods mostly for furniture and for interior trim. Both types of wood are used for boxing and crating.

Practically all woods contain both heart and sap wood. The sap wood is that which lies just inside the bark, and through which the sap still flows. As the tree grows it adds new rings of sap wood, and the inner rings of the sap wood gradually cease to carry sap, and turn into heart wood. Heart wood is much preferred, because it is stronger and denser than the sap wood, and because it is less subject to decay.

Why Wood Decays.—The decay in wood is caused by a fungus very similar to the fungus which causes the decay of fruits. In order to grow, this fungus must have warmth and moisture, and the less moisture the lumber contains, the less liable it is to decay. The growth of the fungus may be prevented by excluding the air by creosoting, or by other similar processes, but this adds greatly to the expense.

In this connection may I call attention to the factors which enter into the determination either to treat railroad ties or not to treat them. Theoretically, the treating of railroad ties would add greatly to the life of the ties as it prevents decay. If the ties are on a line where liability to decay is great, and where traffic is comparatively light, there can be little question as to the desirability of creosoting.

Where Creosoting Doesn't Pay.—If, however, the ties are for an elevated street railway, it does not pay to creosote,

because heavy traffic actually wears out the ties before they could decay. Again, it would add an undue fire hazard to creosote ties used for the railroad in a mine. There is another process of treating ties known as the zinc method, but this process cannot be economically used for electric railroads because of the action between treated ties and the electrically charged rails.

Because problems connected with the purchase of lumber are so complicated, it is practically impossible for the purchasing agent to master all the intricacies in a short time. If you have a particular problem that has not been solved to your complete satisfaction there are open to you the following authoritative sources of information: Various associations of lumber dealers, publications of the Forestry Bureau, Washington; and of the Forestry Department of the University of Wisconsin, Madison, Wisconsin.

The University of Wisconsin is equipped to make exhaustive investigations of special problems connected with the production of and uses to which lumber and lumber products are put. If you spend a good deal of money every year for lumber and lumber products, it would pay you to spend a few days in the laboratory of the Forestry Department of the University of Wisconsin.

If you have the time or inclination to pursue the study of the problems connected with the purchasing and utilization of lumber, I refer you to the following publications:

LUMBER

Kellogg, Royal Shaw, "Mine Timbers," Forest Service, Circular No. 49.

Betts, Harold Scofield, "Lumber Saved by Using Odd Lengths," Forest Service, Circular No. 180.

"The Seasoning of Wood," U. S. Department of Agriculture Bulletin No. 582, also 509 professional paper. See also Bulletin No. 104 of the Forest Products Laboratory.

"Sawmill Statistics," Forest Service Circular No. 107.

Bryant, Ralph Clement, "By-Products of the Lumber Industry," Special Agents' Series No. 110, U. S. Department of Commerce.

"Prices of Lumber," Government Printing Office.

Butler, Ovid McQuat, "The Wholesale Distribution of Softwood Lumber in the Middle West," U. S. Department of Agriculture Report No. 115.

Dunlap, Frederick, "Kiln Drying Hardwood Lumber."

TRADE JOURNALS

"American Lumberman."

"Lumber Trade Journal."

CHAPTER XV

PAPER¹

A Great World Industry.—The indomitable Mr. H. G. Wells, in his “Outline of History,” expresses the opinion, in discussing the “Renascence of Western Civilization,” that it was paper that made the “revival of Europe possible.” He adds that “not until the end of the fourteenth century was paper abundant and cheap enough for the printing of books to be a practicable business proposition. Thereupon printing followed naturally and necessarily, and the intellectual life of the world entered upon a new and far more vigorous phase.”

Be this as it may, it is at least indisputable that paper has become one of the necessities of modern life; and the paper industry has grown until it is one of the great industries of the world. This growth has really been an accompaniment of the amazing economic, industrial, and intellectual development which has characterized the Nineteenth and Twentieth Centuries.

It was not, for instance, until early in the Nineteenth Century that the Fourdrinier paper machine was invented, and it was not until the third quarter of the Nineteenth Century that wood pulp came to be the principal raw material for the manufacture of paper.

Production in the United States.—Today, the manufacture of paper of all kinds and of wood pulp ranks about fifteenth (in value of product) among the industries of the United States. The output of paper in 1920 was about 7,335,000 tons, or about 140 lbs. per capita; whereas in 1899 the total production was about 2,200,000 tons, or about 57 lbs. per capita; and in 1920 the value of the various paper products produced in the United States was more than \$1,000,000,000. The 7,335,000 tons produced in 1920 represented about 90 per cent. of the capacity of the 1653 paper machines in the 818 paper mills then operating in the United States. In the total of 7,335,000 tons were included: paper—or box-

¹By C. C. Whinery, of R. R. Donnelley & Sons Co., Chicago.

board, 2,323,000 tons (value, about \$200,000,000); newsprint, 1,512,000 tons (value, about \$1,500,000); wrappings, 1,404,000 tons; book paper, 1,405,000 tons (value, about \$220,000,000); fine papers, 389,000 tons (value, about \$1,500,000); felts and building papers, 367,000 tons; and tissues, 178,000 tons.

All Must Buy Paper.—Paper, indeed, is one of the comparatively few commodities which anyone who buys anything—certainly any purchasing agent—must of necessity buy. Unfortunately, the manufacture of paper has not yet attained in all respects the status of an exact science. Therefore, the buying of paper must often be done upon an empirical, rather than upon a purely scientific, basis—by the method, that is, which psychologists are fond of calling the method of “trial and error.”

One should, for example, bear in mind that the quality and various important characteristics of any lot of paper are determined not alone by its constituents, but also, and sometimes predominantly, by the judgment, the efficiency, the experience, and the skill of the mill superintendent or operative. It is for this reason that the answer given by a famous painter to an inquisitive neophyte has been paraphrased into the statement that paper is made out of—materials and brains.

In a single chapter it would be impossible to deal specifically with all of the many kinds of paper, or to deal exhaustively with any; and this chapter, therefore, will be limited to a brief consideration of those papers which are probably of greatest interest to the greatest number—that is, to papers commonly known as newsprint, book papers, and writing papers.

Buyers' Minimum Equipment.—In general, it may be said that the buyer of paper who wishes to buy judiciously and intelligently needs as a minimum the following equipment: He must be familiar with the different kinds and grades of paper, and with the principal mill brands and merchants' brands, and their characteristics; he must have at least an elementary knowledge of the principal manufacturing processes; he must have a general knowledge of the materials used in the manufacture of different kinds of paper, and of the characteristics of these materials, and must know what distinctive qualities each imparts to the paper of which it is an ingredient; he must know how paper is marketed; he must be able to ap-

praise samples, and to select with judgment a paper which is best adapted to the specific purpose in view; he must know how to inspect and test papers; he must be familiar with so-called "trade customs"; and finally, he must keep in touch with the broad movements of the industry, and with market and business conditions in general, if he is to decide wisely when to buy freely and when to buy sparingly.

The Buyer's Personality.—With all this equipment, however, the purchasing agent concerned with the buying of paper would be unfitted for his task unless he had as well certain fundamental qualities which are necessary for effective and wise buying of any commodity. He must be scrupulously fair and impartial; he must be able to select the best sources of supply; he must establish relationships of good will and mutual confidence with manufacturers, merchants, and brokers; and above all, and as a matter of course, he must have common sense and good judgment.

Constituents of Paper.—Paper has been well defined as "an aqueous deposit of vegetable fibre." The fundamental constituent is cellulose (chemical formula, $C_6H_{10}O_5$) an inert substance, almost insoluble; and a paper can be made from any plant.

In practice, however, only a few kinds of vegetable fibre have so far been used to any extent—both because these few are intrinsically better than others for this purpose, and because they are available in such form and in such quantity as to make them commercially suitable. For centuries prior to the Nineteenth Century, paper was made almost exclusively of cotton and linen rags; that is, of flax and cotton cellulose fibres. The best papers are still made of these materials, chiefly because they have a very high cellulose content, and also because flax and cotton fibres are distinctively long and strong.² Rags, however, vary greatly in quality, and some rag papers are conspicuously inferior to others, and even to papers made chiefly or wholly of wood pulp.

Mechanical Wood Pulp.—In 1918 more than five and one-quarter millions of cords of wood were consumed in America in the manufacture of wood pulp. Wood first came into general use for this purpose about 1840, when a process of grinding wood blocks was developed. This process yields the

² The cellulose content of different plant fibres varies widely; for cotton it is about 90 percent., for flax about 80 percent., for jute, about 64 percent., for white spruce, about 57 percent., and for straw, about 40 percent.

so-called mechanical or ground wood pulp, which contains all of the impurities of the wood (e.g., the so-called lignins, which readily oxidize upon exposure to air), and whose fibres are short and weak.

Paper made chiefly of mechanical wood pulp is therefore short-lived, discolours readily, and has little strength. Ground wood paper, however, serves admirably for newspapers, because it is relatively cheap, is opaque, and is so absorbent that ink quickly dries as the paper is printed.

Chemical Wood Pulp.—After the American Civil War, so-called chemical wood pulp became available (through the invention of the sulphite process by Benjamin C. Tilghmann, an American) for use commercially on a large scale. This pulp is produced by separating through chemical action the cellulose in the wood from all impurities. The processes most commonly used are those known as the sulphite (acid), soda (alkaline), and sulphate (alkaline) processes; and the pulps resulting therefrom bear these same names. In the sulphite process, bisulphite of lime is used as the solvent; in the soda process, caustic soda; and in the sulphate process, a combination of sulphate of soda, sulphide of soda, sodium hydroxide, and sodium carbonate.

Sulphite pulp is the most common constituent of book papers of all kinds. It is used extensively in making cheaper grades of bond and writing papers; and in newsprint it is used to bind and give strength to the ground wood, usually from 20 per cent. to 25 per cent. of sulphite being combined with from 80 per cent. to 75 per cent. of ground wood. Mitscherlich pulp is a variety of sulphite made by a more prolonged treatment of the wood blocks with comparatively weak acid; paper made of it is tougher and stronger than that made of ordinary sulphite.

A paper made of sulphite alone, without considerable "loading," or without an admixture of other kinds of pulp, would be unduly transparent. Soda pulp is used in many papers in combination with sulphite. It is inferior in strength, but imparts softness and mellowness and greater bulk to a sheet. If, however, an excess is used, the paper is likely to be "fuzzy," and thus cause trouble in the pressroom, particularly in offset printing.

Sulphate pulp produces an exceptionally strong paper, and is the principal constituent of such papers as Kraft

wrapping papers. For sulphite and sulphate pulp as well as for the best mechanical pulp, spruce and hemlock are most used; for soda pulp, poplar, aspen, balsam, beech, and pine. Highly resinous woods are suitable for the soda or the sulphate, but not for the sulphite process.

Additional Sources of Fibre.—Other fibre-contributing materials used commercially are waste paper, and straws and grasses such as (in England) esparto, a grass which grows in Spain and in North Africa. For straws and grasses the soda process chiefly is used. Old and waste papers are used very extensively, especially perhaps in the Middle West, not only in manufacturing boards, but also as a principal or important constituent of all kinds of book papers, and often with unsatisfactory results, because (among other reasons) the waste papers may have been improperly sorted, and the fibres are likely to be weakened in being re-worked into new paper.

Non-fibre Materials.—The principal constituents of paper, other than vegetable fibres, are: (1) sizing materials, chiefly rosin or vegetable size, and, for the finer papers, animal size, or gelatine. The function of the size is to make the paper more resistant to moisture, and thus more capable of "carrying" ink; blotting paper, for instance, is wholly unsized.³ (2) Loading materials or fillers. The principal filler is a very fine china clay (a hydrated aluminum silicate), the best of which is imported from England, though much American clay is now used. This loading adds weight, and gives opacity and smoothness of surface to the paper. Other fillers sometimes used are talc, asbestine, precipitated chalk, and various forms of calcium sulphate, such as gypsum and pearl hardening.

Bleaches, Dyes and Colours.—Among the minor constituents, though often very important, are bleaching agents (chiefly chlorine), and dyes or colouring agents (sometimes pigments or mineral colours which act as fillers also, and sometimes dyestuffs or aniline dyes); these are required not only for all coloured or tinted papers, but even for the so-called white papers. These white papers are generally classified, as regards

³The rosin size is applied in the beater (referred to hereafter), where it is precipitated from solution by sulphate of aluminum or alum; the animal size is applied by running the paper through a vat of gelatine after it leaves the paper machine. Hence, rosin-sized papers are called "engine-sized" and animal-sized papers are called "tub-sized" papers. An unsized pure cellulose paper is called "water-leaf."

colour, as "natural" (for which no dye or very little is used), "pink-white" (for which a red dye is used), and "blue-white" (for which a blue dye is used).

Coated Paper.—The so-called coated papers consist of a base of ordinary paper (frequently of poor quality), covered either on one or both sides by a mixture of casein (or sometimes glue or starch), and a coating material, such as china clay, blanc fixe (barium sulphate), or satin white (a combination of calcium sulphate and aluminum hydrate). The function of the casein (glue or starch), is to make the coating adhere firmly to the body of the paper. The coating materials provide a smooth, even printing surface, so that coated papers are especially in demand for fine half-tone printing. Often two or more of the materials just enumerated are combined to secure a special finish. Satin white provides a higher finish and a smoother surface than either clay or blanc fixe, and blanc fixe is much used for so-called dull finish coated or "mat" papers—i.e., papers which have a smooth finish but little gloss or "shine"; such papers are lightly calendered. The use of starch as an adhesive prevents the securing of a glossy finish. By its application a low, rather than a shiny, finish may readily be secured, but starch imparts undue absorbency, so that half-tones (especially those printed in colours) are likely to be dull. Moisture is apt to affect injuriously all starch-sized papers.

The Manufacture of Paper.—The processes of manufacture are somewhat intricate. They have for their object (1) the isolating of the cellulose fibres and the freeing of these from impurities; (2) the forming of these fibres, mixed with water and other constituents such as those referred to above, into a web or sheet of paper; and (3) the drying, smoothing, finishing, and cutting of this paper.

The principal machines used, after the fibres have been isolated, are:

1. A "beater," in which the fibres are separated from one another and cut to even lengths, and in which the various constituents, including colouring agents, which go into a particular lot of paper, are thoroughly mixed, or "beaten" together, into a creamy mass of the proper consistency.* This mixture, or the formula for it, is called the "furnish."

* This, of course, applies only to uncoated paper and to the "body stock" for coated paper; the special pigments or dyes, the casein, the coating, etc., required for coated paper being applied later in the coating mill.

In the opinion of many, it is in the beater chiefly that the quality of the paper is determined, and it is the beating which calls for the most experience and skill; for instance, the duration of the beating has much to do with determining the characteristics which the paper is to have.

2. The Jordan, or refining engine, really a supplementary beater, into which the mixture, now called the "paper-stuff" or simply "stuff," passes from the beater itself. This is a cone-shaped machine—the paper-stuff is made more homogeneous, and the fibres are further separated and somewhat torn or bruised. From the Jordan, the paper-stuff passes to a "stuff-chest," and then to the "paper machine."

3. The "paper machine" chiefly used is the Fourdrinier, which in its primitive form was invented by Nicolas Louis Robert, of France, but which takes its name from Messrs. Henry and Sealy Fourdrinier, English stationers, who further developed it.

The most distinctive feature of this machine is an endless revolving wire screen on to which the paper-stuff flows, and upon which the paper is formed in a continuous sheet, or web, the fibres tending to arrange themselves lengthwise, in the direction in which the wire is moving, thus determining the "grain" of the paper.

Deckle Edges.—The paper-stuff is confined to the screen and prevented from overflowing by an adjustable strap, known as the "deckle strap," at each side, and the characteristic broken, or uneven, edges of the web are known as the "deckle edges"; these are generally trimmed off but sometimes, especially if it is desired to imitate hand-made paper, they are retained.

An ingenious device imparts to the screen a shaking or oscillating motion, which causes the fibres to interlace or mat more thoroughly as water is drawn by suction through the meshes of the screen, and the fibres contract and curl about one another.

From this wire the wet web,⁵ now fully formed, is carried by belts to a series of heated dryers, felt-covered rolls

⁵ Just before leaving the wire the still wet paper passes under a small roller covered by a wire screen, and known as the "dandy roll," by which, if the paper is to be water-marked, the water mark is imparted by the pressure of a raised design. Sometimes a series of straight parallel lines is thus impressed into the paper as water marks. Such paper is known as "laid paper," in distinction from the ordinary sheet, which is called "wove paper".

or cylinders, between which the web passes. From these rolls the web is generally transferred to calenders, vertical stacks of solid or hollow steel cylinders, which complete the process of drying, and smooth the surface of the paper. Some papers are later passed through a long series of additional calenders, a process which is known as supercalendering and which imparts a high finish or sheen even to uncoated papers. Of the rolls or cylinders in a stack of calender rolls, only one is driven; the others rotate by friction and it is this friction which gives the sheet, traveling at high speed between the rolls, its high finish.

In drying and calendering, it is important to make the two sides of the web of paper uniform in appearance and finish, but often differences are very noticeable; the side which was in contact with the wire screen, the impress of which often remains, is called the "wire side," and the other side, the "felt side."

Delivery in Rolls or Sheets.—After leaving the dryers and calenders, or the "dry end" of the paper machine, the web is wound on rolls and may be delivered in this form to the customer if the order calls for such rolls; but, if the order calls for sheets, the paper is cut by a cutting-machine into sheets of the prescribed size, or into stock sizes.*

Even when the paper is to be delivered in rolls, the width of the rolls required is likely to differ from that of the web; the web is therefore slit on the machine to the desired width, and the paper then wound in two or more sets of rolls. If the combined widths of rolls ordered by one, or by different customers, equals or nearly equals the width of the machine, the machine is said to have a "good fill." The widths of different machines vary widely, some machines being as wide as 200 inches; and the speed at which the endless wire screen moves may vary from 200 ft. or less to 1,000 ft., or even more, a minute. As a rule, the slower the speed the better the "formation" of the paper.

* Finer writing and ledger papers are often cut into sheets before being "tub-sized," and are then dried on racks in a special drying room. These papers are said to be "loft-dried." Instead of being smoothed and finished by calenders, they are placed between plates of metal, and subjected to great pressure. These papers are said to be "plate-finished." "Linen" finish is imparted by placing pieces of linen between the metal plates and the paper, which thus receives the impress of the linen. "Linen papers," therefore, are not necessarily made of linen rag, or even of rag.

Other Machine Types.—Paper machines—other than the Fourdrinier—commonly used are the Harper machine, which is really a modification of the Fourdrinier and is used for manufacturing thin, light papers; and the cylinder machine, which operates on a different principle, the wire screen being on a revolving cylinder, the lower part of which passes through a vat of paper-stuff, upon which the paper forms much as it does on the wire screen of the Fourdrinier machine. The film of paper is then transferred to a felt which carries it to the drying rolls and calenders.

A single-cylinder machine is used for the manufacture of tissues; a double or multiple-cylinder machine chiefly for the manufacture of boards, the thin sheets from the different cylinders being automatically pressed together to form a single thickness.

The coating of papers is a separate process and is often performed in separate coating mills. After the coating is applied and brushed evenly, and the paper is dried, the web passes through a series of supercalenders, where it is highly polished.

Many Papers Short-Lived.—Much of the modern paper made by these modern processes is subject to comparatively rapid deterioration and decay. For instance, the addition of an excess of sizing and of loading, and the excessive heating and compression which often occur in drying, particularly in calendering, weaken the paper and make it relatively short-lived. Coated papers are especially subject to deterioration.⁷

Principal Classes of Paper.—A complete list of the different kinds of paper and of the uses to which they may be put would fill several pages. For convenience, however, paper may be broadly grouped into the following classes: (1) newsprint, (2) book papers, (3) writing and ledger papers, (4) cover papers, (5) tissue papers, (6) glassine and grease-proof papers, (7) blue print papers, (8) glazed and fancy papers, (9) wrapping papers, (10) vegetable parchment, (11) blotting paper, (12) filter paper, (13) wall paper, (14) safety papers, (15) board, including cardboard, box-

⁷ See a pamphlet by F. P. Veitch, "Durability and Economy in Papers for Permanent Records" (Report No. 89 of the U. S. Department of Agriculture, 1909); The report of a committee of the Society of Arts on the "Duration of Paper," London, 1898; and Chapter XII in Sindall's "Manufacture of Paper," London, 1908.

board, chipboard, pasted chipboard, bindersboard, and corrugated board, (16) roofing and building papers, and (17) a miscellaneous group, in which would fall the paper material used in manufacturing articles ranging all the way from wheels for railway cars, to a fabric which closely resembles cotton cloth, and has been used successfully for men's clothing.

Numerous Subdivisions.—Each one of these groups is again subdivided. Of newsprint, for instance, we have standard news, catalogue news, and half-tone news; and of book papers, opacity, India, machine finish (or M. F.), English finish (or E. F.), sized and supercalendered (or S. and S. C.), antique, eggshell, offset, coated or enameled (called "art paper" in England), imitation coated, and cover paper.⁸

Moreover, papers in each general group, and sometimes those in different subdivisions of the same group, are sold on a distinctive basis of weight and size; and "trade customs" which apply to one group or subdivision may not, and often do not, apply to the others.

Simplification Needed.—To the novice all of this is bewildering and confusing. Many of the confusing elements seem to be needless and unintelligent; they appear to be largely survivals, through inertia, of traditions and customs; and the need of simplification and reform is patent.

Meanwhile, it is necessary that the buyer should constantly bear in mind, among other things, the basic sizes and weights in which different kinds of paper are now sold. Among the basic sizes are:

Book paper, 500 sheets to the ream	25	x	38
Newsprint, onion skin, and vegetable parchment, 500 sheets to the ream	24	x	36
Wrapping, waxed and tissue paper, 480 sheets to the ream	24	x	36
Writing, railroad manila and envelope paper, 500 sheets to the ream	17	x	22
Cover, 500 sheets to the ream	{ 20	x	26
	22½	x	28½
Blotting, 500 sheets to the ream	19	x	24

⁸ No attempt to define all these subdivisions is made here, because definitions are of little value. A novice should obtain samples of each kind, and thus learn to identify them and become thoroughly familiar with the distinctive characteristics of each. Some papers may belong to two of the classes mentioned above; thus an "opaque" or "opacity" paper may be an M. F., an S. and S. C. or an E. F. paper.

Mill Bristols and cardboard, ⁹											
500 sheets to the ream .....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Index Bristols, 500 sheets to the ream .....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Coated folding boxboards ¹⁰ .....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Bindersboard (bundles of 50 lb. each, the "number" of the board being the number of sheets of the basic size in a 50 lb. bundle.) .....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
26 x 38 .....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Ordinary glazed, 500 sheets to the ream .....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Extra fine glazed, 500 sheets to the ream .....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....

For different groups different "substance numbers" have been adopted in America, these substance numbers being certain standard weights for 500 sheets in a basic size. For instance, the substance numbers for book paper are the standard weights of 500 sheets measuring 25 x 38, other stock sizes being customarily made in weights equivalent to these substance weights. For convenience, the customary substance numbers and stock sizes for book paper, for writing paper, and for cover paper, are given herewith:

BOOK PAPERS, COATED AND UNCOATED

Size	Weight											
	25 x 38	30	35	40	45	50	60	70	80	90 ¹⁰	100	120 ¹⁰
22 x 32	22	26	29½	33½	37	44½	52	59½	66½	74	89	
24 x 36	27½	32	36½	41	45½	54½	63½	73	82	91	109	
25 x 38	30	35	40	45	50	60	70	80	90	100	120	
26 x 29	24	28	31½	35½	39½	47½	55½	63½	71½	79½	95	
26 x 40	33	38½	44	49½	54½	65½	76½	87½	98½	109½	131½	
28 x 42	37	43½	49½	55½	62	74½	86½	99	111½	124	148½	
28 x 44	39	45½	52	58½	65	78	91	103½	116½	129½	155½	
29 x 52	48	56	63	71	79	95	111	127	143	159	190	
30½ x 41	39½	46	52½	59	66	79	92	105½	118½	131½	158	
32 x 44	44	52	59	67	74	89	104	119	133	148	178	
33 x 46	48	56	64	72	80	96	112	128	144	160	191½	
34 x 44	47	55	63	71	78½	94½	110½	126	141½	157½	189	
35 x 45	49½	58	66½	74½	83	99½	116	132½	149	166	199	
36 x 48	55	64	73	82	91	109	127	146	164	182	218	
38 x 50	60	70	80	90	100	120	140	160	180	200	240	
41 x 61	79	92	105	118	132	158	184	211	237	263	316	
42 x 56	74	87	99	111	124	149	173	198	223	248	297	
44 x 56	78	91	104	117	130	156	182	207	233	259	311	
44 x 64	88	104	118	134	148	178	208	238	266	299	356	

⁹ Cardboards and boxboards are figured by standard thickness; for plain cardboard, for instance, these range from 2-ply=.012 points to 14-ply=.048 points; and for boxboards the standard is .016.

¹⁰ These apply to coated papers only.

WRITING PAPERS

Substance Weight in Pounds, Basis 17x22

Size	13	16	20	24	28	32	36	40	44
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
16 x21.....	11½	14½	18	21½	25	28½	32½	36	39½
16 x42.....	23	29	36	43	50	57	65	72	79
17 x22.....	13	16	20	24	28	32	36	40	44
17 x28.....	16½	20½	25½	30½	35½	40½	46	51	56
18 x23.....	14½	17½	22	26½	31	35½	40	44½	48½
18 x46.....	29	35	44	53	62	71	80	89	97
19 x24.....	16	19½	24½	29½	34	39	44	49	53½
19 x26.....	17	21	26½	31½	37	42½	47½	53	58
20 x28.....	19½	24	30	36	42	48	54	60	66
21 x32.....	23	29	36	43	50	57	65	72	79
22 x25½.....	19½	24	30	36	42	48	54	60	66
22 x34.....	26	32	40	48	56	64	72	80	88
22½x22½.....	17½	21½	27	32½	38	43½	49	54	59½
22½x24½.....	19	23½	29½	35½	41½	47	53	59	65
22½x28½.....	22	27½	34½	41	48	55	61½	68½	75½
22½x34.....	26½	32½	41	49	57	65½	73½	82	90
22½x34½.....	27	33	41	50	58	66½	74½	83	91½
23 x24½.....	19½	24	30	36	42	48	54	60½	66½
23 x36.....	29	35	44	53	62	71	80	89	97
24 x38.....	32	39	49	59	68	78	88	98	107
24½x24½.....	21	25½	32	38½	45	51½	58	64	70½
24½x28½.....	24	30	37	45	52	59½	67	74½	82
24½x29.....	24½	30½	38	45½	53	61	68½	76	83½
24½x38½.....	32½	40½	50½	61	70½	80½	90	101	111
25½x44.....	39	48	60	72	84	96	108	120	132
28 x34.....	33	41	51	61	71	81	92	102	112
34 x44.....	52	64	80	96	112	128	144	160	176

COVER PAPERS

20x26-25, 35, 50, 65, 80, 90

23x33-36½, 51, 73, 95, 117, 131

26x40-50, 70, 100, 130, 160, 180

33x46-73, 102, 146, 190, 234, 262

Proposed American Decimal Standard.—Various suggestions for the reform of the present chaotic conditions have been made. Of these the most promising is that makers, sellers, and buyers of paper adopt a common standard known as the American Decimal Standard, proposed by Mr. Thomas E. Donnelley, while director of the Pulp and Paper Division of the United States War Industries Board. This system was described by Mr. Donnelley in a Government report, as follows:

The ream is entirely eliminated, everything being figured by the thousand sheets. The standard of size is 1,000 sheets of paper one inch square, and the number of thousandths of a pound such 1,000 sheets weigh, is the substance number of any particular piece of paper. For example, a paper of No. 125 substance would mean that 1,000 sheets of that paper, one inch square would weigh .125 pounds, and if we should desire to find the weight per 1,000 sheets of any given size, as 25x38, we would first multiply $25 \times 38 = 950$ to find the number of square inches in the sheet.

If 1,000 sheets one inch square weighed .125 pounds, then 1,000 sheets, 950 square inches, would weigh 950 times .125 pounds, or 118.75 pounds. Should we desire to find the weight of a sheet size 42x61, we would multiply $42 \times 61 = 2562$ square inches, by .125, equaling 320.25 pounds, or eliminating decimals, 320 pounds per thousand sheets.

The same substance number would designate the equivalent weight, whether it were book paper, cover paper, writing, or manila. As stock weights would most probably be even substance numbers, such as 70, 80, 90, 100, 120, 140, etc., the weight of any odd size would readily be found by the simplest multiplication, and there would be no confusion in the mind of the customer because, first: The system is readily explained and easily understood; second: There is but one substance number for the same weight of stock for all classes; and, third: There would be no confusion between the substance number and the actual weight of the stock, as the substance number is a basis unit and not the weight in pounds of some stock size as a standard.

Approved by Printers and Buyers.—This American Decimal Standard has already received the official approval of the following organizations: The United Typothetæ, the Label Manufacturers' National Association, and the National Association of Employing Lithographers; and it is to be hoped that eventually it will be adopted universally.

A somewhat similar standard has been recommended by the Federation of Master Printers in England, the 500-sheet "ream" to be superseded by the 1,000-sheet "mille."

Mill Brands and Merchants' Brands.—Another cause of bewilderment and confusion is the multitude of so-called mill brands and merchants' brands. By mill brands is meant certain papers made by a particular mill as its "standard papers," and sold under names chosen by the mill. These mill brands are advertized extensively, and it is comparatively easy to identify and become familiar with the principal ones.

Merchants' brands, however, are innumerable. A paper merchant may arrange with a mill to manufacture a paper having a certain appearance and certain characteristics, and may sell this paper under a name selected by himself. This brand may not be made regularly by the same mill; in fact, different lots of the same brand may be made by different mills. It is conceivable, also, that substantially the same

paper from the same mill may be offered to the buyer under different names, and perhaps at different prices, by different merchants.

Lack of Uniformity.—In general, therefore, it follows that merchants' brands cannot always be depended upon to have the uniformity and the consistent individuality of mill brands, although different lots of these, too, may and will vary. For an enumeration of current brands, many pages would be required."

Selecting, Ordering and Inspecting Paper.—The importance of judicious selection should be sufficiently obvious, but it is safe to say that a large part of the paper bought annually is not bought as judiciously as it should be. The buyer of paper should never forget that it is his function, first of all, to buy for a given purpose a paper which will best serve that purpose; and that the price at which he buys, though very important and often vital, is really secondary.

The buyer of book paper will probably belong to one of three classes: (1) a publisher, or other customer of a printer; (2) an advertising or other agency, acting as a medium between such a customer and a printer; (3) the printer himself.

As regards the first two classes, it should be unnecessary to lay stress upon the importance of consulting the printer in advance, and getting the benefit of his advice and judgment.

The buyer for the printer, in turn, should have the advice and assistance of the pressroom, of the ink chemist, and of the engraver; he should also be familiar offhand with the "past performances" of different mill or merchants' brands. He should see that the paper selected is one on which half tones or other illustrations chosen for the job in question will print to good advantage."¹¹

Testing the Samples.—It will be advisable, also, to apply to the samples submitted by sellers such of the tests hereafter described as may have special significance in determining which of these samples excel in the qualities especially

¹¹A convenient summary may be found in Lockwood's "Directory" (annual), and in the annual "Paper Record" issued by Walden Sons & Mott, New York City.

¹²In general it may be said that machine-finish paper will take 100-screen, and sometimes as high as 120-screen half-tones; a supercalendered, English finish, or dull coated paper, 133-screen half tones; a good coated paper, 150-screen half-tones; and a double coated paper, 200-screen halftones.

desired for the job for which the paper is being bought. Above all, the fitness of a paper for any job should be tested by subjecting this paper wherever possible to an actual trial; by running sheets through a press, by proving them with different inks, by folding them, and by binding them into a dummy.

Word Orders Carefully.—After the paper has been selected, great care should be taken in wording the order so that there shall be no chance for controversy or misunderstanding later. Each order should specify accurately the quantity required, the exact dimensions of the sheet or roll to be supplied, and either the exact ream weight in these dimensions, or the exact basic weight.

The colour, finish, and formation are usually best indicated by a sample, one half of which should be given to the seller, and the other half attached to the buyer's file copy of the order. Any special understanding with regard to the materials to be used in making the paper should be specified explicitly in the order itself; and the price should be so stated as to leave no doubt as to whether the freight and cartage are to be paid by the seller or by the buyer.

Direction of the Grain Important.—It is generally essential also that the direction of the grain in sheets ordered should be specified. This is usually done by underscoring the dimension in the direction in which the grain is to run; sometimes by adding after the specification for dimensions the words "cross grain" or "straight grain," the former meaning that the grain is to run the short way of the sheet, and the latter that the grain is to run the long way. In general, the grain should so run in a sheet that, in a bound book, it will be parallel with the backbone; otherwise, the book will not open properly (especially when flexibility is desirable), and if the pages are subjected to moisture (e. g., when glue or paste is applied to the cover in binding), the paper is likely to "cockle."

In the case of very light weight papers, such as India, it is not so essential that the grain in a bound book shall run parallel with the backbone. In fact, it may even be desirable that the grain should run at right angles to the backbone, so as to give greater firmness and rigidity to the book, if these qualities should be desired; and the sewing or stitching is likely to hold better. In cases in which the folding quality is im-

portant, the grain should run in the direction of the fold, as any paper is more likely to break when folded against, than when folded with, the grain.

Place Your Order Early.—Whenever possible, the buyer should issue his order early enough to enable the manufacturer to make and deliver the paper at least a short time in advance of the date when it is to be used. This will provide an opportunity for seasoning, and often expensive and exasperating delays in the pressroom, caused by the expansion or shrinkage of paper, can thus be prevented.

It is to be remembered that cellulose is highly hygroscopic—that is, has a strong affinity for water. Dry paper, therefore, which is stored in a humid atmosphere absorbs moisture; this causes the fibres to expand, and a sheet of paper to stretch, chiefly across the grain, as a dry fibre when immersed in water will increase as much as 20 per cent. to 30 per cent. in diameter, though its length may be increased by only about one-tenth of one per cent.

Properly Packed Paper.—Further, the buyer should see to it that all paper is properly packed. With regard to this, the Paper Committee of the National Association of Purchasing Agents has made the following recommendations:

Rolls.—All rolls, not crated or cased, should be protected on edges by fibroid or heavy board collars, covered by a cap of strong, heavy paper. Book papers of all descriptions, bonds, ledger and blue print paper, in rolls, should have a waterproof wrapper in addition to collar and cap. Fancy box covering papers, easily injured, should be packed in waterproof lined cases.

Flat.—All papers for printing or lithographing should be packed flat in frames or cases. If for register colour printing, they should be packed in cases with good waterproof lining. Coarse papers for wrapping may be packed in lapped bundles; tags, cheap bristols and similar board not intended for unusual printing may be packed in bundles, with cardboard protectors on edges, and well wrapped.

The following papers, whether for printing or other use, such as glassine, coated glazed, embossed, flint papers and box coverings, cover paper, bond writings, weddings, ledgers, gummed, tracing, and other thin papers, Bristols and coated boards should be packed in waterproof lined cases. A sheet of chip or news board at the bottom, and on top of paper, is an additional and almost necessary protection.

Additional Precautions.—It will be noticed that nothing is said in these recommendations with regard to the packing of book papers in lapped bundles, but if such bundles are made up properly and are carefully protected—especially their ends—the cheaper grades of paper can be shipped in this manner with a fair degree of safety.

All packing cases containing sheets of paper should continuously be kept flat—both in transit and in storage; otherwise, there is serious risk of crumpling. Paper received in soft fold bundles should be unpacked as soon as received and should be promptly piled in the storeroom or pressroom.

Points for the Inspector.—Each lot of paper should be carefully inspected as soon as possible after its delivery, and as long as possible before it is printed. The inspector should determine whether sheets have been cut to the correct size, and whether the cutting has been done evenly; whether the weight is in conformity with the order (within the limits at least fixed by trade customs); whether the grain runs in the direction specified; whether the finish and colour are uniform, not only as between different sheets, but as between the different sides of the same sheet; and, in the case of coated papers, whether the coating is uniform and adheres properly to the body of the sheet.

For reasons previously suggested, it seems as yet impracticable for the average buyer, even of large quantities of paper, to buy by exact scientific specifications. The United States Government, however, has been a pioneer in buying its paper in this manner, and the experiment seems to have worked successfully. It is to be noted that such all-important qualities as colour, finish, and formation are specified as yet, even by the Government, by sample only.

The Testing of Paper.¹³—Anyone who buys paper in any quantity should have at least a ream scale, by which he can readily determine from one sheet, or a part of a sheet, the weight of 500 sheets of a given size, a Mullen or Ashcroft tester to determine bursting strength, a micrometer and a bulk tester. Also every buyer should have at hand a small bottle of phloroglucine (i.e., phloroglucinol dissolved in hydrochloric acid) or of nitric acid, by which he can detect at once the presence, in any sheet, of ground wood. If ground wood is present, a drop of nitric acid will turn the paper brown, and a drop of phloroglucine will turn the paper

¹³ The methods of testing are fully described in several books referred to at the end of this chapter, and more specifically, in a pamphlet entitled "Paper Testing Methods," published in 1920 by the Technical Association of the Pulp and Paper Industry, and in Circular No. 107 entitled "The Testing of Paper," issued by the Bureau of Standards, Washington.

rose-pink or magenta.⁴⁴ Papers which contain no ground wood are commonly designated as "free papers" or "free sheets." The presence of starch can readily be detected by applying to the paper a dilute solution of iodine, which, if starch is present, will cause a blue-black stain. The relative weight of the loading can be determined by weighing a piece of paper, burning it, and then weighing the ash—which will represent fairly accurately the original loading.

Testing for Grain Direction.—The direction of the grain can usually be determined by folding or tearing a sheet in each direction, as the folded edge against the grain is more likely to crack, and the torn edge is likely to be more fibrous, than in the direction of the grain. Another method, effective for sized papers only, is to moisten one side of a small piece, cut square, whereupon the paper will curl, and the grain will lie in the direction of the curl.

A third method is to hold together vertically, and then incline from side to side, two narrow strips cut from the same sheet; the first cut in one direction, the second in the other direction. The strip which falls away from the other by its own weight will be the one in which the grain is crosswise instead of lengthwise, as paper is more flexible against the grain than with the grain.

Other Tests.—The wire side of a sheet may be distinguished from the felt side by immersing a sample in water and then draining off the excess, whereupon the wire marks will be apparent on the wire side.

A simple method of testing the relative opacity of two sheets is to place samples of these sheets side by side over a printed page, and then note through which one the type shows more plainly. A more accurate method is to cut a small slit in a piece of cardboard, place this cardboard between the eye and some bright light, and determine how many sheets, or just what thickness, of each of the papers under comparison, will, when placed over the slit, wholly obliterate the light.

⁴⁴If phloroglucine is applied to a paper which has been coloured with certain aniline dyes (e.g., metanil yellow), the paper will turn pink, even if no ground wood is present; but this reaction is almost instantaneous, and the colour is even, whereas ground wood colours somewhat slowly and not uniformly. The phloroglucine solution should be kept in a dark place as its staining properties are affected by light.

The folding quality can be tested roughly by making two intersecting folds at right angles to one another, and then reversing the sheet and making the same folds in the opposite direction. At the point of intersection a poor-folding paper will break noticeably.

The Tests for Strength.—Relative tearing strength can be gauged by tearing with the fingers, but each sheet should be torn both with the grain and against the grain, as a sheet always tears more easily with the grain than against it. The familiar Mullen test will measure numerically the bursting strength of a sheet, but the significance and value of this test are often misunderstood and overestimated; any sheet should always be tested in several different places, and an average result arrived at.

Paper Finish and Coating.—Some idea of the relative finish of two coated papers can be gained by looking against the light along the surface of each and by examining each under a strong magnifying glass. To test uniformity of finish, rub powdered graphite (e.g., from a lead pencil) over the surface and see whether the resulting smudge is uniform, or mottled and "spotty." To determine whether the coating adheres properly to the body of the stock, heat one end of a stick of sealing wax, apply this to the surface and when it cools remove it; it will withdraw only the coating from a poorly coated sheet, but will withdraw both the coating and some or all of the underlying "body stock" from a well-coated sheet.

Another, but less satisfactory, test is to crumple a small piece of the paper in the hand and note whether the coating drops off readily; and a third test is to moisten the thumb, press it hard on the paper, and see whether the coating material sticks to the thumb. If the coating does not adhere firmly to the body stock, trouble in printing is probable through the picking or flaking of the coating material.

Formation of a Sheet.—The so-called "formation" of a sheet is always significant. This is easily judged by looking through the sheet against a strong light. If the texture is uniform, the formation is said to be even; if it is wavy—that is, if it appears mottled and patches of fibre are evident—the formation is said to be "wild." A wild formation is usually evidence of unskillful manufacture, but it should be borne in mind that it is easier to attain evenness if fibres are short;

and other things being equal, long fibres give greater tearing strength, and a better folding quality.

All of these tests can easily be applied without expensive apparatus. In special cases, however, more elaborate tests are often desirable. These can best be obtained from an outside laboratory, as few companies would find it profitable to maintain a special laboratory for this purpose. Such tests may be grouped broadly into three classes: physical, chemical, and microscopical. The physical tests include accurate numerical measurements of tensile strength and of folding strength, for which such instruments as the Schopper tensile machine and the Schopper folding machine are frequently used; for measuring tearing strength there has not yet been devised any perfect instrument, but that known as the Elmendorf tearing tester is widely used; colour values and gradations are measured by a colourimeter, and the relative fastness of colours by a fadeometer; the degree of gloss is measured by an Ingersoll glarimeter; and for the measurement of bulk under different pressures a Perkins bulk tester is used.

Chemical and Microscopical Tests.—Chemical tests determine, among other things, the percentage of ash, the quantity and kind of loading, or sizing, and of coating material used, and the presence or absence of free acids.¹⁵ The chief value of a microscopical test is to determine the character and relative percentages of the fibre content. This is done by placing a representative lot of fibres upon a slide, colouring them with reagents, and then estimating through the microscope the number of each kind. By these special laboratory tests information which is often very significant and valuable in connection with other tests may be obtained; and such information if properly used may be a very valuable aid in selecting and buying paper.

The Paper Trade.—Paper reaches the consumer either direct from a mill, or through a broker who may represent several mills, or through a paper merchant. It has been estimated that all except a small percentage—probably less than 10 per cent.—of newsprint paper, and possibly more than one-half of all book paper manufactured, reaches the consumer through direct sales by mills or their agents, or brokers representing these mills, rather than through sales by paper

¹⁵ Free acid in paper may cause much difficulty in printing (e.g., in offset work), and will injure and disintegrate the fibres.

merchants; but the percentage of book papers sold by merchants seems to be steadily increasing. The products of some of the largest and best mills, for instance, can be bought only from certain merchants designated as their "distributors." Most of the writing paper and the wrapping paper which is manufactured is sold through merchants, and the merchants perform a highly important function, both for the mills and for the public, in that they carry at all times quantities of papers in stock sizes.

The American manufacturers of paper (and pulp) are organized into a national association known as the American Paper and Pulp Association, and the merchants into a national association known as the National Paper Trade Association.

Trade Customs.—The rules or practices governing the purchase and sale of different classes of paper are expressed in a somewhat elaborate (and often confusing) series of "trade customs," with which all buyers of paper should be familiar. They are printed in the price lists of many paper merchants and copies may readily be obtained.

These trade customs establish for each class of paper the basic size and weight for that paper, and the regular stock sizes and weights. For each class of paper a minimum basic weight is established; and it is provided that a certain prescribed extra charge shall be made for any lot lighter than this minimum basic weight.

As regards book papers, for instance, the minimum basic weight for a machine-finish paper is 45 lbs.; for supercalendered paper, 50 lbs.; for paper coated on one side, 60 lbs.; and for paper coated on two sides, 70 lbs. The prescribed extra charge for lighter weight machine-finish paper is arrived at by adding 1 per cent. of the selling price for each pound, or fraction thereof, below 45 lbs., down to and including 35 lbs.; 2 per cent. of the selling price for each pound, or fraction thereof, below 30 lbs.; and 3 per cent. of the selling price for each pound or fraction thereof, below 30 lbs., down to and including 25 lbs.

For supercalendered papers the corresponding differentials are: 1 per cent. for weights between 50 lbs. and 40 lbs.; 2 per cent. for weights between 40 lbs. and 35 lbs.; and 3 per cent. for weights between 35 lbs. and 30 lbs.; and for coated paper (coated two sides), 1 per cent. for each pound

between 70 lbs. and 45 lbs.; and 2 per cent. for each pound between 45 lbs. and 35 lbs.

These trade customs further provide that a minimum mill run, without extra charge, for a paper in a regular size, colour, and substance weight shall be 2,000 lbs.; and for an irregular size in a regular colour and substance weight shall be 5,000 lbs.; and for a regular or irregular size in an irregular substance weight shall be 10,000 lbs.

Overruns and Underruns.—As regards variations between the quantity ordered and the quantity delivered, the trade customs provide that any overrun or underrun not exceeding 15 per cent. for an order for less than 5,000 lbs., not exceeding 10 per cent. for an order for between 5,000 and 10,000 lbs., not exceeding 5 per cent. for an order for between 10,000 and 40,000 lbs., and not exceeding 3 per cent. for an order for more than 40,000 lbs., is to constitute a good delivery.

As regards variations between the ream weight specified in the order, and the actual ream weight of the paper delivered, trade customs provide that a variation not exceeding 5 per cent. above or below the ordered weight when between 45 lbs. and 100 lbs. basic weights, and 8 per cent. when below 45 lbs. or above 100 lbs. basic weights is permissible. Paper within this range constitutes a good delivery, it being specified, however, that if there is an underweight in excess of 2½ per cent. for uncoated or of 5 per cent. for coated paper, the paper is to be charged for at the actual weight instead of at the weight specified in the order.

With certain qualifications it is specified that no claim of the buyer against the seller on account of the delivery of defective paper is to be valid, if the claim is made "after the paper is cut, ruled, or printed, or otherwise made commercially defective."

Buyer Must Know Customs.—These provisions, all of which apply to book papers only, will give some idea of the scope and character of the trade customs now in effect. Although in practice exceptions are made, it is assumed that every individual buyer is familiar with and is willing to abide by these trade customs.

It would seem obvious that when trade customs are established for any trade, the interests and the point of view of the

buyer as well as those of the seller should be taken into account. Buyers, however, are likely to be unorganized, though important groups of buyers of paper are represented in such associations as the United Typothetæ and the National Association of Purchasing Agents. The United Typothetæ have contended for the adoption by the paper trade of a so-called "long list," the essence of which is that the printers' share in the marketing of paper shall be recognized by granting them special discounts.

References.—A convenient list of publications relating to paper up to 1913 may be found in a pamphlet, "The Bibliography of the Pulp and Paper Industries," Forest Service Bulletin No. 123 of the U. S. Dept. of Agriculture, and there is a later and more complete list issued by the Committee on Bibliography of the Technical Association of the Pulp and Paper Industry, and published serially in the "Paper Trade Journal" during 1920 and 1921.

The following books will be found useful: W. B. Wheelwright, "From Paper Mill to Pressroom," Menasha, Wis., 1920, a brief popular summary; R. W. Sindall, "The Manufacture of Paper," London, 1908, and "Paper Technology," London, 1910; G. S. Witham, "Modern Pulp and Paper Making," New York, 1920, intended chiefly as a manual for those engaged in the making of paper; E. Sutermeister, "The Chemistry of Pulp and Paper Making," New York, 1921, somewhat technical but containing useful information for the general reader; and E. A. Dawe. "Paper and Its Uses," London, 1919.

Among special journals published in America are "Paper," "The Paper Trade Journal," and "The Paper Industry." A useful monthly report concerning production of pulp and paper is issued by the Federal Trade Commission. Lockwood's Directory, published annually, is an indispensable manual.

CHAPTER XVI

PAPER SUPPLIES USED IN CREAMERY INDUSTRY¹

Creameries of Recent Growth.—It has been in the last fifteen or twenty years only, that butter has been churned and packed in the way that it is today. In earlier days, the only butter produced was on the farm, and it was made in a very crude way. Later, creameries were organized in the same manner that weaving, shoe making, and flour milling were made specialized industries.

Under the new system, butter was made in creameries, to which farmers brought whole milk, which was separated, the cream being used in churning, the skimmed milk being returned to the farmer for feeding purposes. Through the introduction of the hand farm separator, a further improvement was developed, and in place of hauling large quantities of milk every day, the farmer, through use of his own separator, could make deliveries of small quantities of cream at his convenience. The development of the Babcock test—a method by which the fat in the cream or milk can be rapidly and accurately determined—and the use of the farm cream separator, led to the present system of creamery operation.

Cream is now gathered in country towns, or shipped directly to the central churning point, where, under the most sanitary conditions and scientific methods, a uniform quality of butter can be produced.

This method of operating affords a greater opportunity for producing butter on a large scale, and under more exacting methods than was possible in the past. Supplies of all sorts necessary in the operation of a creamery can be purchased in quantities, and at correspondingly lower costs.

Farmer and Consumer Benefited.—Standardization is possible on a large scale, and, in general, a service is rendered to

¹ By H. W. Post, Purchasing Agent, Beatrice Creamery Company.

both the farmer and the consumer at a cost much less than would be possible the way butter was made years ago.

The problem of the creamery, after the cream has been bought and churned, is to sell the finished butter. Prior to the introduction of the present system, butter was distributed in a very crude way by "commission men." Butter was packed and handled in tubs largely, and from the tubs cut into various sizes and shapes or packages, or cut right out of the tub and sold over the counter.

As competition became a greater factor, it was found necessary to sell butter under a brand carrying the guaranty of the maker. In other words, by packing and branding in special packages, a demand could be created and a constant outlet afforded. The development of the package idea for butter led to one of the most important uses of paper in the creamery industry.

Paper for Wrapping Butter.—Buying paper supplies of various sorts for wrapping butter is one of the most important duties of the creamery purchasing agent.

Butter was packed at first in muslin or cheesecloth. Today the first wrapping on butter is what is known as parchment paper. This paper is made largely from sterilized rags. Parchment paper is odourless, and therefore does not taint the product it wraps. It also keeps out all odours that might contaminate the butter. Unlike other papers, parchment when saturated with water is rather difficult to tear. It becomes more like a piece of cloth. The sulphite papers, or ordinary stock made from wood pulp, would break apart when moistened.

Creameries generally use a 30-pound stock for wrapping print butter of one-quarter, one-half, or pound size. At first, 25-pound stock was used, but it was found a little too light in weight, and did not keep the butter as well as the heavier stock. Any heavier stock than 30-pound would be too heavy to use on a small package.

Printing on the Wrapper.—Many concerns use printed parchment, putting their trade-mark and various advertising features in ink on the parchment, while others use both plain and printed. Parchment paper is cut in standard sizes for the butter trade. The most common size is the 1-pound, 8 x 11 inch parchment. A considerable amount of butter is still packed in tubs for wholesale trade, and these tubs are lined

with parchment and have a top and bottom circle. This stock is usually 30-pound weight.

Butter tubs and their parchment liners and circles are more nearly standardized than the prints. Most creameries still wrap their butter by hand, but the wrapping machines are gradually replacing hand work.

Packing in Cartons or Wrappers.—After the butter is wrapped in the parchment, some creameries pack in cartons, while others add a second wrapper of waxed or paraffined stock. This second wrapper is made from sulphite stock, and may be waxed or paraffined on one or both sides. The best grade of wax paper is prepared with special grade paraffine wax, most of which comes from India. This paraffine has a melting point of from 138 to 140 degrees Fahrenheit.

Some creameries hand-wrap the wax paper around the butter, while others use machines for this operation. Some machines place the wax paper inside the carton, as it is formed on the machine, and interlock the carton and the wax liner between the two ends, making an air-tight, dust-proof package.

Wax paper should always be kept in a cool place. If stored in a warm room, it will stick together in one solid mass. Sometimes wax paper shipped during the summer months sticks together. Where this happens, it is necessary to pull the sheets apart one at a time. If the paper sticks through heating, it may be placed in a cooler or freezer until chilled, when it hardens sufficiently to permit handling. Two styles of cartons are used in packing butter; one a plain paraffined carton, and the other a heavily paraffined, printed carton.

Board for Cartons.—Several kinds of board are used in making cartons. Most plain cartons are made from cracker shell, manila-lined chip board, solid news, or solid manila. While some of these cartons are printed, many are plain and enclosed in an outside paper wrapper. Printed cartons are mostly made from patent-coated, solid, manila stock, or sulphite stock, bleached on one or both sides.

The thickness or "caliper" of the board is not the only consideration. It is important that the carton have sufficient body to keep its shape when filled with butter. For instance, if a 24-point board without much body were used, the carton would lose its shape as soon as it became moist. This would not be a satisfactory carton for butter. On the other hand,

a 15-point board, calendered hard, might be found quite satisfactory.

When the carton is to be made on a machine, another factor must be considered. Board for this purpose must be just stiff enough to form properly, without creasing or losing its shape when the cover is down.

Keeping the Butter Sweet.—The paraffined carton helps to keep in the flavour of the butter and to keep out all odours. Practically all butter cartons are paraffined on one or both sides. Board is paraffined by passing it over warm rollers, one of which runs in a paraffine bath. The hot board readily absorbs the melted paraffine. The board is then cut into proper sizes for cartons. If a printed carton is used, the board goes from the rollers through a bath of cold water. This sets the paraffine on the board, and gives it a highly glossed finish.

A great deal of butter sold today is packed in printed cartons. A highly glossed finish and good printing make a very satisfactory and attractive package. Many prefer a package made with a printed wrapper over a plain carton, because it is a sealed, air-tight and dust-proof package. Wrappers for this style package are usually printed on book stock coated on one side, although other papers are sometimes used. Two kinds of coating are used in the manufacture of this paper, one made from starch and the other from casein.

Paper Coating and Colours.—The casein coating is made from buttermilk, a more satisfactory coating than starch, for casein adheres to the raw stock better. The white paper used for wrappers is cut from 25 x 38 inch, 55-pound stock—that is, 55 pounds to 500 sheets.

Should coloured paper be used for packing butter, the paper must be a good grade and have good colour to withstand the salt or brine, which sometimes comes out of the butter on to the wrapper. If it does come out, and the paper has not been treated, the colour will run and spoil the package. Most colouring used in the manufacture of butter wrappers is specially made to withstand the effects of salt or brine.

In some creameries the outside wrapper is put on by hand, but in others it is machine-wrapped. With machines the packages are more uniformly wrapped, with less waste, and with considerably less labour than would be possible in wrapping by hand. As a rule, wrappers are purchased in sets. In other

words, one wrapper and two seals make a set for one package.

Use of Paper Containers Increasing.—After the wrapper is placed around the filled carton, it is put into containers for convenience in handling and shipping. Wood is used to some extent, but paper containers have displaced wooden boxes in many plants, because wood requires too much space, and adds to the freight charges. Paper containers are also cheaper, and are more economically put together.

There are two paper containers which are usually used, the straight fibre-board container, and the corrugated container. Fibre board is made principally of chipboard, with a jute liner. In some instances a manila liner is added. The corrugated container used by a great many shippers, not only for butter but many other commodities, is usually made with a jute liner with a back of sulphite screenings or chip, and a corrugated centre of strawboard. When made and sealed properly, these two packages are satisfactory for butter.

Container Strength Guaranties.—Under present express and railroad regulations, a certain strength board is required for each size package. All container manufacturers stamp their containers with a guaranty of strength, and state that it complies with tariff regulations. A 60-point board should be used for weights up to 40 pounds. From that weight up to 65 pounds, an 80-point board should be used; and for weights up to 90 pounds, 100-point board is used. At present, the 50-pound container is the largest size used for shipping.

At first, containers were closed with kraft sealing tape, on both top and bottom. Later, a machine was invented for stapling bottoms and sides with copper wire. Sealing tape is then used on the top only. This makes a very substantial package. Machines have recently been invented that will not only staple the bottom and sides, but will also staple the cover after the container has been filled.

In many cases, butter is packed in wooden boxes. These are usually made of either poplar or spruce. Some woods may not be used because they have a strong odour, and butter put into storage or kept any length of time in boxes made of these woods absorbs the odour of the wood.

Standardizing Forms.—Besides knowing the paper supplies and materials used in packing butter, it is necessary for the creamery purchasing agent to familiarize himself with all kinds of paper used in the stationery of the business. It is

very important to standardize forms as nearly as possible and thereby be able to buy in quantities.

Most of the forms in the creamery office, outside of ledger and register sheets, are made up on 16-pound medium grade bond, although letterheads are generally printed on 20-pound stock. Forms should be of such size as to cut from stock without waste if possible. The purchasing agent should also familiarize himself with printing and lithography, in order to be able to buy economically. Many times several colours are used on a letterhead, or other printed matter, which could be eliminated without detracting from the effectiveness of the general appearance.

It is important that the punching on all forms for binders be of standard size and distance apart, so that they will fit standard or stock binders. This helps to cut down the cost of special binders for different forms.

Watching the Various Markets.—In buying supplies and equipment for the creamery industry, as in any other line of business, the purchasing agent should keep in close touch with the markets on the various supplies he is buying. This information can be obtained by keeping in contact with the supply manufacturers, by reading market reports in the newspapers and trade journals, and by consulting other buyers.

There is no one best time in which to buy any commodity. It all depends on market conditions. In the creamery business we buy many of our supplies in the early spring, because much more butter is churned and packed during the spring and early summer than the rest of the year.

CHAPTER XVII

PURCHASING AUTOMOBILE TIRES

Finding the Right Tire.—The purchasing agent who is responsible for the purchase of a large number of automobile tires should know the whole history of the materials that enter into their manufacture, and be familiar with the various methods of manufacture, and the advantages and disadvantages of each. The conditions under which various weight trucks operate vary so greatly from month to month, and from one locality to another, that the shrewd purchasing agent must necessarily do a good deal of experimenting, before he finds the tire that is best suited to the needs of his particular business.

Ordinarily, the firm that sold the trucks for which he is purchasing automobile tires, will have a considerable body of data on the first cost, and the maintenance charges, for tires of the various kinds for their particular trucks. This data, checked and verified by his own experience, under his own particular operating conditions, is the only guide the inexperienced purchasing agent can at first use.

Records Will Show Results.—If, however, the operating department keeps careful records not only of the mileage received from each tire, but of the kind of truck it is used on, the routes it runs, whether city or town, and the sort of drivers in charge of the trucks using the tires, the purchasing agent will be able in a short time, to form an adequate opinion concerning the merit of the type of tires in service at any particular time.

Finding the tire that just fits your particular needs, and your particular operating conditions, and which produces the maximum amount of service at the minimum cost, must necessarily be the result of considerable careful study. A safe policy is to strive to profit by the experiences of others, whose operating conditions approach yours, and then try to improve upon their findings by careful study, and the exercise of your purchasing ability and sense of values.

Tire Rubber.—Automobile tires are built of rubber of various kinds, mixed with various compounds, and strengthened by fabric of various types. Crude rubber, as everyone knows, is the congealed latex of certain shrubs, vines, and trees that thrive in tropical countries. This latex is not, strictly speaking, the sap, as it is drawn from the bark. The latex is carried through the bark by a series of tiny veins not unlike the lymphatic system of the human body.

An analysis of the latex of the heva tree, which produces most of the commercial rubber, is as follows:

<i>Constituents</i>	<i>Percentages</i>
Rubber	37
Albumen	3
Rosin	5
Water	52
Traces of oil, sugar and other foreign matter	3

In its natural state, rubber is insoluble, except in certain volatile oils. Because rubber is soluble in certain oils, the continued contact with any oil tends to shorten the life of any rubber product.

Native Rubber.—Originally, all rubber was of the wild or native type, and the commercial unit was the ham, which was built up by dipping a stick in the latex, and drying the adhering film over a wood fire. The hams were built up by hand, one layer at a time. The process was slow, and these hams often were found to contain a considerable amount of foreign matter, at first because of the inexpertness of the natives, later because of dishonesty.

Plantation Crepe.—As the name implies, plantation, or crepe rubber, is that obtained under cultivation. The method of preparing the plantation rubber most in use is to skim and strain the latex, and then pour it into a large tank, adding a weak solution of acetic acid. This mixture is allowed to stand over night, and the crude rubber is found floating on the surface in the morning. The last step in the manufacture of crepe is to wash, and sometimes, to smoke it. It is white when first washed, but turns yellow with time. This is the plantation crepe rubber with which we are all familiar. The imports of rubber for 1919 and the sources were as follows:

<i>Sources</i>	<i>Long tons</i>
Plantations	192,270
Paras	27,058
African	3,340
Centrals	1,423
Guayule	1,501
Manicabo and Malto Cross	440
	—
	226,032

Tire Fabrics.—The second element in the manufacture of automobile tires is the fabric. As the automobile tire depends almost entirely upon the several layers of cotton fabric for its strength, it follows that the tire that is built to wear must have a carcass reinforced by fabric made from the strongest possible cotton. The strongest cottons available are the Egyptian and the so-called Sea Island cottons.

Egyptian cottons are used mostly by the European tire builders, while the American manufacturers depend almost entirely upon the Sea Island cotton, and its more recent rival Pima cotton. Sea Island cotton was so called because it came from a group of Carolina off-shore islands which had just the right climatic conditions to produce long staple cotton of great strength. Pima cotton comes from irrigated land where ideal growing conditions are artificially obtained. The Bureau of Standards Bulletin Number 68, page 15, contains the details of certain tests made to determine the relative strength of combed Sea Island cotton, and carded Egyptian cotton.

Mill and Bureau Tests.—The mill tests showed that the tensile strength of a test piece varied from 213 pounds to 262 pounds, while the Bureau of Standards showed the breaking point to vary from 219 to 230. The carded Egyptian cotton varied little, the average being about 190 pounds.

It should be added that all these tests were made under identical atmospheric conditions, because even a rather slight increase or decrease in the moisture content would distort the results. Tests indicate that up to 10 per cent. the increase of each 1 per cent. in the uncombined moisture contained in the cotton not only increases the weight and improves the appearance of the tire fabric, but actually increases the tensile strength 7 per cent. Because of this factor, it is of prime importance that the purchasing agent who buys large quantities of tire fabrics not only have the means of testing all

deliveries made, but that he also have adequate inspection facilities, and that he be prepared to check accurately the amount of moisture in the samples, and in the fabric delivered.

A careful tabulation of the results of testing several hundred samples shows that the average moisture content in number one tire fabric is about 4.85 per cent.

The Manufacture of the Tires.—When the crude rubber is received at the tire factory, it is all inspected and carefully dried. It is then ready to be compounded. The various compounding formulas vary widely. These compounds are added because pure rubber does not possess the necessary wear resisting qualities.

Without a certain amount of sulphur the tires would be very short-lived. Other compounds commonly used are lamp-black which not only darkens the stock, but toughens it somewhat; zinc oxide, which toughens the stock, and adds to both the tensile strength and the wear-resisting qualities; lithopone, which adds a reddish colour and hastens the vulcanizing process; litharge, barium, sulphite, and whiting, which act merely as inert fillers. Under certain conditions varying amounts of linseed oil products and mineral hydrocarbons are added to soften uncured stocks and to act as fluxes.

The process of manufacturing an automobile tire is, briefly, that of forcing live rubber through the fabric, and then building up the tire with alternate layers of the tire fabric and rubber, after which the tire is cured and vulcanized by the application of both heat and pressure.

Cord Versus Fabric.—The cord tire differs from the fabric tire in that it is strengthened by heavy cords in crisscross layers. These cords have just enough cross threads to keep them in place. In other words, the fabric in the cord tire is made up of heavy warp, with just enough woof to keep the warp in place.

It is claimed, apparently with good reason, that the cord tire, when properly built will outlast the fabric tire, because the cords adapt themselves more easily to the changes in the road bed and in the load, and there is a minimum amount of friction and heat generated inside the tire from the action on the road. Fabric tires are quickly burned up by heat generated by friction on the road when they are run under severe loads, or when they are run at excessive speeds.

The Economical Choice.—It would seem, then, that as fabric tires are somewhat less expensive than cord tires, they would prove to be admirable for small light cars that do not travel at high speeds; but that, for heavy duty, or for the car that must travel at high speed, or must travel over rough roads, the cord tire would be the best investment in the long run.

The cord tire is more nearly a complete unit, and does not tend to go to pieces under the stress and strains of the road. Fabric tires usually first show signs of failure along the sides, where layers of fabric begin to come apart under the combined action of pressure and strain on the side walls under flexure.

CHAPTER XVIII

TEXTILE PURCHASING DIFFICULT

A Test for the Buyer.—More fully perhaps than in any other line, does the purchase of textiles test the resources of the modern purchasing agent. There are so many different types of textiles, which may be used for such a wide variety of purposes, that the process of selecting the one textile that will produce the greatest value per dollar expended is far from simple. In purchasing textiles of various kinds the purchasing agent may have the aid of a complete chemical and testing laboratory, or he may have to operate with very little equipment save his native shrewdness, and his ability to judge the fairness and the honesty of the vendor.

In any case, however, he ought at least to have a pocket linen glass, and a teasing needle. If he has no teasing needle, an excellent substitute may be made by pulling the rubber from the end of the lead pencil, forcing a pin through it lengthwise, and then returning the rubber to the end of the pencil. This gives you a fine point mounted on a handle. With the aid of the glass and the needle it is possible accurately to count the threads per square inch in both the warp and the woof of the cloth under examination.

The Linen Glass.—The linen glass is nothing more than a small magnifying glass, mounted over a folding base that has an aperture exactly one-quarter inch square. With the aid of the glass and the home-made teasing needle it is quite easy to count the number of threads running each way within the quarter inch aperture at the base of the glass. By multiplying this number by four you get the number of threads per square inch. For instance, a piece of cheese cloth that shows seven threads running one way and eight threads running the other way is known as a 28 x 32 count cheese cloth.

Many considerations enter into the purchase of textiles of various kinds for various purposes. Some of these considerations must be taken into account in the purchase of any textile, and all of them have to be taken into account for the purchase of some. They are as follows:

UNITS IN TEXTILE VALUES

- A. Tensile strength
- B. Resistance to wear
- C. Ability to resist the action of special factors, such as the presence of moisture or acids
- D. Heat conductivity, or lack of conductivity
- E. Appearance
- F. Permanency of this appearance
- G. Sizes in which available
- H. First cost, and maintenance cost

Tensile Strength.—The tensile strength of the sample under consideration can be tested by any one of several simple devices which record the breaking point under a uniform pull. Resistance to wear is just a bit more difficult to determine as, in order to make a fair test, the actual service conditions under which the goods will be subject to wear must be duplicated, if the test is to be of any value.

There are numerous machines on the market which are designed to duplicate actual wearing conditions. Some of these machines have been developed by the Bureau of Standards for carrying on the tests at the Bureau. Full information concerning these wear-testing machines may be obtained by addressing the Director of the Bureau of Standards, at Washington. Some of these are available commercially, and some of them are not.

Special Factors.—The ability of various samples to withstand peculiar conditions under which the materials must be used, when purchased, may only be determined by duplicating in the laboratory, as accurately as may be, actual conditions. If the amount of material to be purchased is large, it is usually desirable to check farther the findings of the laboratory, by first trying out a number of samples in the shop before the whole lot is purchased.

In arranging for the laboratory tests of any material, it is well to keep constantly in mind the fact that the laboratory tests can, at best, only approximate on a small scale, actual tests to which the material will be put in service. These laboratory tests are of great value and every modern purchasing agent should have at least occasional recourse to a reliable laboratory, but in the last analysis the only complete test is the ability of the given product to stand up under actual operating conditions in actual service.

Laboratory Tests.—These general remarks concerning the value and the limitations of laboratory tests can best be illus-

trated by the tests of rubber heels and composition soles the Bureau of Standards conducted for an Eastern manufacturer, two years ago. The manufacturer had sent to the Bureau a number of pairs of rubber heels, and a number of composition soles of various compositions.

The Bureau examined the material under the microscope, and submitted small samples to chemical analysis, but its real test was that of actual service. A number of employees were fitted out with the rubber heels and the composition soles. In some cases, the employees wore one composition sole and one leather sole. In some cases, they wore one of the new composition soles, and one of another standard make. The report the director of the Bureau of Standards made upon the wearing qualities of the various pieces was based largely upon the wearing tests, which the manufacturer could have conducted for himself without any machinery whatever.

Heat Conductivity.—In certain textiles, the ability to act as non-conductors of heat is of prime importance. Much of the value of woolen goods depends upon the fact that they are good non-conductors of bodily heat, and so tend to keep the wearer warm. In the purchase of certain types of textiles, the appearance, and the fabric's ability to retain this pleasing appearance for a reasonable length of time, is of prime importance.

The suiting may have a pleasing stripe effect, but if the stripes wear off the second week, it is not nearly as valuable as it might be. A prime requirement for suitings is a pleasing appearance, and this pleasing appearance should last until the material is worn out; but another requirement is that the material should not wear too long! Most suitings used in this country are intentionally constructed so they will last one season and no longer, and so that they will look well for the entire period of their life. Because of this fact, nearly fifty per cent. of the wool used in this country is re-worked wool, or "shoddy." There can be no possible objection to the use of a certain percentage of re-worked wool, if the finished material does not need to withstand long and hard wear; and because of the short fibre of the re-worked wool, materials made from it, or materials which contain a high percentage of it, do not wear long.

No Objection to Shoddy.—Now, as the use of re-worked wool lowers the cost of the fabric, and as the fabric, generally

speaking, lasts until the styles change, there can be no objection to the use of re-worked wool or shoddy. An added argument, and a good one, in favour of the continued use of re-worked wool, even in our best suitings, is that at the present rate of consumption, and at the present rate of production, there would not be enough wool in the country to give everyone a new suit each year.

It is a well known fact that woolen cloths may be turned out that will not only last more than one season, but will last practically for a generation. For instance, the average French peasant buys one new suit when he is married, and he wears that same suit for all state occasions until it comes time to be buried in it. Because he normally does not have one new suit a year, but only one new suit in a lifetime, he must have a suit of clothes made of materials that will withstand that sort of wear.

That kind of material could be turned out in this country as well as in France, or Scotland, if there were a large demand for it. Because the demand is for materials which will last only about one season, however, the mills are not equipped to turn out the better quality of suitings, and under our factory methods, the cost of producing only a limited yardage would be prohibitive.

Textiles Are Costly.—The purchase of textiles soon mounts up into considerable sums of money, rendering it necessary for the purchasing agent to exercise the greatest skill in the selection of the material which will deliver the greatest amount of service per dollar expended.

The purchasing agent who buys thousands of yards of silk bolting cloth of a given specification every year, without knowing at first hand that bolting cloth of that particular specification will, under the working conditions existing at his plant, deliver the maximum amount of service per dollar expended in material, or in labour necessary in putting that material in service, is not serving his firm or institution to the best of his ability. He is not making the best of his opportunities. Note that it is not enough to know which bolting cloth will deliver the greatest number of hours' service per dollar expended, without knowing absolutely that there are some other factors that more than offset the supposed economies in using that particular kind of material.

If, for example, the total unit cost of the material, plus the

total cost of taking off the old material, less the salvage value of the old material per unit, is higher than the cost of another type of material, plus the cost of changing, minus the value of the salvage, it is up to the purchasing agent to find that out before any one else makes the discovery.

Buyer Must Know.—You may argue, and not without justification, that it is the duty of the purchasing agent to buy the material specified by the operating department, and that to attempt to dictate specifications to the operating department simply will lead to difficulties between the departments, and get neither anywhere. That is quite true. The purchasing agent for any firm who expects to remain with that firm long, must early learn not to dictate to any department head.

If you will follow the changes which take place within any large organization, you will invariably find that the department head who attempts to dictate to any other department head for any length of time, usually succeeds in eliminating himself sooner or later.

You should not attempt to dictate to the mill foreman the sort of bolting cloth that should be used. If, however, there exists a real doubt concerning the fitness of that particular kind of bolting cloth for your particular kind of service, it is up to you to reinforce your ideas and convictions with a large body of facts concerning the prime and other costs of that item, and the costs of other types of material that will do the same work.

Learn the Reasons Why.—If your costs are twice as high as those in a similar plant, you can find ways of learning the reason for your high costs, or your neighbours' low costs. The mere fact that a material is the kind of material you have always used is no argument for its continued use, but is rather one of the strongest possible arguments in favour of a careful canvass of the facts, or supposed facts, which originally led to the selection of that material.

The world does not stand still, and the intelligent change of supply items, and the intelligent, well-thought-out substitution of one item for another, may mean all the difference between having the net results of the year's operation written in black figures, or in red figures.

Change Only When Necessary.—Do not misunderstand me. It is the greatest of folly to be continually changing items unless there are good reasons for each change. If, however, your investigations seem to prove conclusively that

a change should be made in a material, if you are a purchasing agent possessed of the amount of judgment and skill you are supposed to have, you can place those facts in the hands of the head of the operating department in such a manner that he will not only feel bound to accept and take advantage of the information, but will feel indebted to you for helping him locate the leak before it was brought to his attention in a more disagreeable manner by some higher official.

If you are not quite sure of your approach, and the possible reaction, can you not plan your campaign so that it will appear that the discovery is not yours, but that of the operating foreman? It may not at first glance seem right or fair that another man should be deliberately given an opportunity to profit by your work. On the other hand, it is not so very important who receives the immediate credit for effecting a certain given economy, as long as the firm benefits thereby.

You have the satisfaction, the experience, and the added knowledge gained through your study of the problem, and when the directors learn, as they eventually will learn, that these economies have been the result of your work and your knowledge, your position will be very much stronger than it could possibly be if you were immediately to claim every jot of credit when earned. Sometimes it is a mighty good thing to have a credit balance upon which you can draw, if need be.

Two Ways of Losing Money.—It is nearly as common to find we are losing money through the use of material not good enough for the purpose to which it is put, as it is to find we are using material that is better than needed. The continued use of any material that is not under the existing conditions best fitted to a particular purpose, results in a money loss that cannot easily be offset, and produces an economic waste.

This does not mean that we should scrap all our old equipment as soon as a more modern type is available, but it does mean that as soon as more modern equipment is available, we should at once analyze our operating conditions to determine whether the change in machinery will result in permanently lowered costs, or whether the change will result in an added burden because of the lack of demand to take up all product of the new machinery at a profit. If new machinery will double our output, but the market will not absorb the additional output at a profit, it is not enough to lower the direct unit cost.

CHAPTER XIX

THE PURCHASE OF ADVERTIZING

Pay the Asking Price.—Many purchasing agents have at various times been called upon to purchase advertizing. Sometimes they have attempted to negotiate the purchase of advertising space much as they would attempt to purchase a car of sugar, or a car of steel. The scientific purchase of advertising, however, requires a new kind of purchase-technique. All reputable advertizing mediums protect the advertizing agencies, and no reputable advertizing agency will split a commission with any client under any circumstances. In this particular line of business the buyer is much better off if he pays the full price asked.

In the purchase of advertizing space, the purchasing agent must depend a great deal upon the assistance and advice of the agency man. If he tries to go it alone, he will usually find his advertizing appropriation is mostly wasted. All well established advertizing mediums have a fixed rate, which is published, and distributed freely to all who ask for it. This is the price asked, and is the price the advertiser must pay. Recognized agencies receive an agency commission, which is usually 15 per cent. If you deal with the advertizing medium direct, you pay the same amount you would pay the agency, and you do not get the agency service. In this respect there is no purchase-function in the buying of advertizing space. Once the medium is selected, you simply pay the price asked and there is nothing left to do but verify the fact that the advertizing has been run, and see that the bill is paid.

Special Training Essential.—In another and broader sense, however, the purchase of advertizing calls for a type of purchase-function that is very highly specialized. Just as it is the duty of the purchasing agent to see that the materials and supplies that he purchases are the supplies and materials that are best suited to his particular plant, it is the duty of the buyer of advertizing space to see that he selects the sort of medium that will bring in the greatest number of inquiries

per dollar expended. Moreover, it is his business to see that these inquiries emanate from the sort of prospective customer who is able and willing to buy the sort of material or product he is trying to sell. In order to find the medium that will bring in the greatest possible returns per dollar expended, it is necessary to carefully analyze and compare the circulation of the mediums under consideration. Accurate information concerning the circulation of periodicals is furnished by the American Bureau of Audits which is supported jointly by advertizers and publishers. Dailies are required by law to publish semi-annual affidavits on circulation. No one who has not had considerable experience selecting and testing advertizing mediums and interpreting the data secured can expect to do this satisfactorily without wasting a lot of time and money.

For this reason it is folly to attempt to place advertizing without the aid and counsel of a competent advertizing agency. As the agency is interested in the commissions it will earn, and as these commissions will grow only as its clients prosper, it is to the best interest of the agency to work for your profit, and to that end alone.

Advertizing is such a broad subject that we cannot hope to more than cover the elements in a discussion of this sort. With this brief introduction, I shall next describe an advertizing campaign. This campaign was originally drawn up in the form of a lecture given before the students of the University of Chicago course in purchasing by Mr. F. D. Mayer, of Chicago.

BUYING ADVERTIZING SPACE

To talk intelligently on the subject "Buying Advertizing Space" would necessitate some interrogation on my part. First, I should have to know what kind of advertizing you are going to buy—newspaper, magazine, street car, billboard circularizing, club mailing, telephone canvass, trade papers, window display, or moving pictures. Next, the agency man must know for what purpose you wish to advertize—to sell something, or to buy something.

Buying Is Done Easily.—If it is our purpose to buy something, then the medium to be used is easily selected, because sellers respond quickly. If the space is to be used to sell something, other questions must be answered. There is the question of what quantity, and the answer to that question might

cause us to decide that it does not pay to advertize that commodity. Advertizing is not merely buying space, as we shall show from the following hypothetical case.

Hypothetical Problems in Advertizing.—Suppose our firm has built a new addition to the factory, and we want to move the output from that new addition. We would analyze the situation as follows:

1. What are we going to sell? That is of greatest importance.

2. The kind of package, label, container, or trade-mark. These are important factors.

3. Will the "copy" be an illustrative appeal, or will it be argumentative?

You can illustrate cookies by the expression on the kids' faces, but it takes argument and comparisons to prove the torsional strength of a 14-inch iron beam.

The Artist Must Interpret.—Let us assume that our product is a new brand of condensed milk. That calls for educational and suggestive copy. That means we will have to have an artist; and securing the services of an artist is a bigger job than appears on the surface, because we must find just *the* artist who can visualize our own idea of what this wonderful, new, improved, last-word-in-perfection condensed milk is.

Any artist can draw a pretty picture, but *our* artist must draw into this particular picture or series of illustrations, the ideals that we have conceived in regard to this new brand of milk.

When he draws a picture of the condensing room, he must intuitively feel the cleanliness of his surroundings, so that the illustration, when it comes before the public, will breathe wholesome, sweet cleanliness. This artist must be able to "sense" our enthusiasm, and every picture that he draws must express joy by reason of its contact with the "best condensed milk in the world," and no amount of exaggeration will show this on paper. It must be there so that the people will "feel" it rather than "see" it.

The Copy Writer.—Next, we must have a copy writer, the man who is going to write the ads. He must be "sold" on the big idea of the wonderful new brand of condensed milk that we are going to put out. He must be able to write copy that will make the average milk consumer think of our particular

brand of condensed milk every time he sees a coffee cup, and he must be able to write convincing copy with the use of few words.

You may be able to find this artist or this copy writer in the office of some reliable advertizing agency, and yet you may have to search through every studio and university in the city to find him—but *find him you must*. Now, we are ready to analyze the demand for goods of this character, and from two angles: (1) we must find out from reports which we shall be able to secure from concerns that make analyses and investigations of this kind, the number of brands of condensed milk there are on the market at the present time. They will also tell us the seasons in which they sell, whether heavier in summer than winter, and in what localities. They will tell us the lines of resistance, etc. (2) We may find that for this particular article it is necessary to create a demand. There may be potential possibilities for this particular kind of product, but the public has not yet been educated to its use.

Preparation of Campaign.—Our advertizing campaign may, therefore, have for its purpose the education of the public to the use of this kind of condensed milk. That these things can be done, and have been done, is best shown by the grape fruit growers of this country. Seven or eight years ago, grape fruit was not popular, but, due to the educational advertizing campaigns that have been run, the grape fruit is now as popular as the orange. Next, we select an advertising agency, if that was not the very first thing we did; and then we must have an advertizing appropriation. The question naturally arises: “How much shall we appropriate?” We are marketing a new article, and we must determine what the appropriation shall be. We proceed to fix the appropriation by a definite process of analyzation, not by guess work, and we analyze it somewhat in this manner:

The Appropriation.—Here is a new plant with a possible output of so many cases of condensed milk per month, and per year, the selling price of which amounts to \$1,000,000 per annum. Having figured the cost of production, and the other overhead expenses, etc., we find that we can afford to appropriate for advertising 10 per cent. of the gross sales, or \$100,000. We therefore recommend an appropriation of \$100,000 for the new condensed milk campaign. We purpose

selling a million dollars' worth of our new milk at a cost of \$100,000. Having our reports before us, showing existing conditions in all parts of the country, we start to analyze the jobber and dealer channel through which this new line of goods is going to reach the consumer.

We prepare to get their coöperation by circularizing.

Reaching Jobber and Dealer.—In other words, we send an announcement to every jobber and dealer in the United States, telling him that we are preparing a tremendous advertising campaign to introduce our newest and greatest product to the American public. Naturally, we recognize the jobber and dealer as most important factors, and as the channels through which we are going to sell our product.

Trade Papers.—Soon the trade papers which are read by the dealers and jobbers, announce we are getting ready to put on the market a wonderful new condensed milk, and that the advertising campaign will be national. A little later full page advertizements begin to appear in the trade papers, telling the jobbers and dealers that the company will soon be ready to lay its plans before them.

Next, our specialty salesmen go on the road, calling on the jobbers and dealers, and by this time jobbers and dealers have a natural curiosity about the plans which, so far, have been kept very secret. In order to take these jobbers and dealers into our confidence, our specialty salesmen are equipped with a prospectus containing reproductions or proofs of the advertizements that are going to appear in the magazines, newspapers, street cars, on billboards, etc.

The jobber is "taken through" the campaign in this manner, and the salesman explains as he goes along about the wonderful demand that is going to be created.

Sales Force.—In each large center, a distributing jobber with a large force of salesmen will be established. Our own travelling salesmen meet the jobber's salesmen on Saturday afternoon, and take them "through" the campaign, explaining the advertising methods to be employed, and the wonderful quality of the milk.

Soon the jobber's salesmen and our own salesmen are calling on the dealers, showing them reproductions of the advertizements and explaining the scheme somewhat as follows:

"Here is a reproduction of our full page advertizements that will appear in the 'Saturday Evening Post,' 'Colliers,' 'Les-

lies,' 'Literary Digest,' 'Ladies' Home Journal,' 'Good House-keeping,' 'Woman's Home Companion,' 'Modern Priscilla,' 'Cosmopolitan,' 'Munsey's,' 'American,' etc., in addition to full page advertizements in your own local newspapers. Our national advertizing campaign will start in the January issues of the magazines. These will all be in the hands of the readers early in January.

"Our newspaper advertizing will start the third Saturday in January. There will be full page advertizements, which will appear in the evening papers. The newspaper advertizements will repeat the 'story' that has been appearing in the weekly and monthly magazines, and will call attention to the full page advertizements to be published in the newspapers on the next day—Sunday.

"Particular attention will be called to the fact that these Sunday advertizements will contain a coupon, good for one large size can of our new condensed milk. They will also carry the names and addresses of all dealers who will have stock on hand with which to fill these orders.

"Naturally you will want to have your name in the Sunday advertizements. First, because you want to be known as an up-to-date dealer; second, because you want your customers to bring their coupons to you for redemption. The manufacturer in turn, will redeem these coupons from you at the regular retail selling price of the can of milk—10 cents, and, of course, to meet this demand, it will be necessary for you to have a stock on hand. The campaign is only six weeks off; therefore, I will take your order now, and see that your jobber supplies you in plenty of time to make a window display, and to have the merchandise on hand with which to redeem the coupons."

It will be seen that by this method, the sales at wholesale all over the country could approximate \$1,000,000 before one advertizement appeared in the national magazines. Now, you are going to ask, how can we afford to print a coupon worth 10 cents indiscriminately in newspapers?

The Coupon.—We can afford to print this coupon in the papers for the following reasons: In the first place, you will notice that I specify Sunday newspapers. Sunday newspapers in some cities sell at 8 cents each and in most towns at 10 cents each, therefore, it would not pay to buy a lot of papers just for the coupon. The person using the coupon makes a

statement over his signature that he has received the can of milk, and the grocer practically makes an affidavit that he has delivered the can of milk to him. The name and address of the party to whom the milk has been delivered is on the coupon.

These coupons, when they come back for redemption are carefully separated into zones or districts, and investigators are employed to cover certain districts. The investigators report to the main office.

The investigator may call on a grocer in his district and inquire as to how his sales are proceeding. He asks: "Is the sale repeating?" If "yes," "how often"; if "no," "what do you think is the reason?"

First-Hand Information.—He may find that Mrs. Smith has reported that the milk is very good, but that it ought to be put up in smaller size cans, because there are only two in her family, and one can lasts two days. If it could be put up in smaller size cans, so she could open a can a day, it would be more convenient.

This is valuable information for the sales department, and by adding a smaller size package to the line, considerable sales resistance may be offset. Much valuable information is secured by investigation.

Various follow-up methods are used, with the name secured from the coupon as a base. A letter is written to the customer, thanking her for having accepted our invitation and having tried the milk. She is asked to give us in the enclosed self-addressed envelope, her opinion of this new milk. This is one method of securing a lot of testimonials.

The Telephone Canvass.—Next, the telephone canvass may be employed. The names on the coupons are carded, and the telephone numbers put on the cards. Young ladies with good voices are employed to call a number, and proceed something like the following:

"Mrs. Jones?

"I am the secretary for Mr. Smith, the local sales manager of the Blank Milk Company. A short time ago, you were kind enough to accept our invitation to try a can of our milk, which you secured from your grocer, Mr. Brown. We are making every effort to please our customers, and to make friends of them.

"I am therefore calling you personally to inquire if the milk

gave entire satisfaction, and if there was anything that did not meet with your entire approval.

"Are you continuing to use our product?"

If so, "Thank you"; if not, "Why?"

Perhaps a woman demonstrator may be sent into this district to follow up these cases of dissatisfaction and show "the lady of the house" how to use this milk properly and why it is the "best in the world."

The Public in Action.—By this time our advertizing has had its influence upon the public. Many of those dealers who refused to buy in the beginning when our specialty salesman called on them are now telephoning their orders to the jobber, not because they want to handle our line of goods, but because the dealers' shelves are a reflection of the customers' demands.

When the demand has been created on the part of the buying public for a certain line of goods, the dealer carries that line of goods, whether he will or not. He knows from experience that a customer wants what he wants when he wants it, and if this particular dealer does not carry what the customer wants, the customer will go some place else, and the dealer will soon be out of business.

Billboards.—In our campaign of advertizing you will notice that we have used national magazines of known, proven worth, both monthly and weekly. We have used newspapers with local circulation to back up and intensify the campaign. Now, we commence to use street cars to keep the name constantly before the public, and our newspaper and magazine advertizing is not so intensive. Also, we are using billboards as a "string around her finger, lest she forget."

For instance, your mother reads our advertisement in her favourite woman's magazine. It appeals to her, and she says: "I must try that new milk sometime." Then she turns the page to something more interesting, and forgets about the new milk. Next month, she sees another advertisement, and says to herself: "Oh, yes, I had intended buying some of that new milk, and I must do it. Mrs. Jones spoke about it the other day," and quickly she forgets again.

Then she sees our newspaper announcements in her home town paper, and decides the next time she goes out, to buy a can of that new milk, but the next time she goes out she forgets again. Today she has been down town.

On her way home from the train, she sees a billboard or a wall sign that calls her attention to our milk, and she snaps her finger and says, "Oh, yes, now I must buy that milk on my way home."

The chances are she is passing a grocery store just about the time she sees the sign, because the signs have been strategically placed in the home neighbourhoods. She goes into the store, buys a can of the new milk, and proves that "it pays to advertize."

CHAPTER XX

PROBLEMS IN COPPER AND BRASS¹

World Production Erratic.—Since the earliest development of the human race, mining and smelting of copper has been known and practiced. Egyptian ruins dating back as far as 4500 B. C. have been found to contain implements made of copper. The hieroglyphics of the period 3500 to 2500 B. C. show that the crucible or melting-pot was used as a symbol for copper. Bronzes manufactured about 2700 B. C. have been found, and the composition of these was found to be held to the formula 88 of copper and 12 of tin, with remarkable accuracy.

During the years intervening between those dark ages and the present time, the uses for copper and its alloys have been greatly extended, and the methods of mining, smelting and refining improved to a marked degree.

The world's production and consumption of copper have been so erratic and abnormal since 1914 that accurate data is unobtainable. That America predominates in the world's production of copper is, however, indicated by the fact that a few years ago, when the world's normal annual consumption was 2,000,000,000 pounds, American refineries were producing annually 1,450,000,000 pounds.

Slump from War Activity.—The 1920 production was approximately 1,560,000,000 pounds, which is only about half the amount produced per annum during the war. To dispose of this country's normal copper production, daily sales must average about 5,000,000 pounds. A carload of copper is really a retail term; 100,000 pounds is a relatively small unit; a million-pound lot is ordinary in periods of activity, and transfers of much larger blocks are common.

Even when the market is classed as dull, the weekly business amounts to many millions of pounds. A single large

¹ Prepared by J. P. Davis, assistant to the president, Belden Manufacturing Co., Chicago, and by an official of a large brass company, whose name is omitted at his request.

electrical manufacturer recently made a single purchase of +0,000,000 pounds of copper.

Although copper has been known and used since remotest times (records indicating that it was the first metal in common use), some of the richest copper deposits of the world have been discovered within the last 75 years. The first copper mine in the New World to be worked by white men was El Cobre near the city of Santiago, Cuba. It had supplied the aborigines many centuries, and was a heavy producer during the World War. Copper was mined in the Colonial times in Connecticut, New Jersey, Pennsylvania, and Maryland. The first mine worked in the United States was the Simsbury Mine, at Granby, Conn. The record of this mine extends back to the year of 1705. It was worked until 1780, but was not profitable, and only a small quantity of ore was taken out.

Sources of American Copper.—The first important Lake Superior mine was the Cliff, which began shipping in 1846, followed by the Minnesota in 1847, and then by the Central, Phoenix, National, and others. These mines, with the exception of the Minnesota, are now exhausted, however.

In 1864, the Calumet lode was discovered, and in 1866 the Calumet Mine was opened. This consolidated with the Hecla in 1871 as the Calumet & Hecla, and began its wonderful career. Between 1870 and 1893 this mine produced more than half the output of Michigan, reaching a maximum in 1898 of 98,000,000 pounds of refined metal and it was for years the largest copper producer in the world. Some of the shafts in these mines are down more than 6,000 feet.

The ore from which refined copper is obtained is now produced in various parts of the United States, although it still comes principally from the northern peninsular of Michigan, Montana, Arizona, New Mexico, and some other Southwestern States. The method of ore treatment differs greatly according to the characteristics of the raw material.

Methods of Ore Treatment.—In the northern peninsula of Michigan, the Calumet & Hecla mines ore contains large amounts of free copper, and their processes of smelting and refining are therefore quite simple.

The Anaconda mines of Montana produce ores which contain large amounts of iron, manganese, arsenic and sulphur, and they, therefore, put most of their materials through a

rather elaborate process in order to eliminate these impurities. Some of the largest producers of the Southwest use quite simple methods, because their ores are easily soluble in sulphuric acid, and it is only necessary for them to leach the raw material for a short time, and then plate out the copper by the electrolytic method. The New Cornelia mine, which is one of the cheapest producers of copper in the country, maintains eight leaching vats, each of which will hold 15,000 tons of ore.

More Precious Metals Saved.—Modern electrolytic methods make possible the saving of the more precious metals found in the copper ore, with the additional advantage that a much purer copper is obtained. The mineral which cannot be profitably leached by sulphuric acid is treated first in a melting furnace, the flame passing from the fire box over the copper, under a low arched roof with a stream of air brought in from below. This is an oxidizing process and the slag that separates from the copper is drawn off from the surface.

After the removal of the slag, charcoal is thrown on top of the melted copper and the liquid mass is agitated by the insertion of green poles of hard wood ("poling"). The ignition of these poles and the charcoal produces the carbon that takes up the oxygen in the copper, thus changing the action of the furnace from an oxydizing to a reducing process. This is often preceded by blowing air through the moulten copper. The copper is tested by dipping small buttons of the moulten mass in a trial ladle from time to time. If the copper sets with a level surface, the process of poling is considered completed, and the copper is run out into molds.

The Slag Remelted.—The slag from the melting furnace is broken up and taken to a blast furnace, or cupola, where it is remelted. The process is substantially the same as the process in the melting furnace, except that limestone, iron, or silica are added to form a proper mixture for fusing, and to aid in the proper separation of the copper. The relative amounts of the several materials to be added depend upon the analysis of the copper and slag mixture. All of the ingredients are mixed with anthracite coal, with or without coke, and a blast of cold air is forced up through the bottom of the mass. The copper drops to the bottom and is drawn off.

This copper still contains a large amount of impurities, however, and must be refined separately. In practice the slag

copper is poured into ingots or ingot bars, but never into wire bars.

Final Refining Process.—After the copper is smelted and somewhat purified, it is given a final refining operation. The great bulk of refined copper is produced by the electrolytic process. The crude copper is first melted and cast into the form of anodes. These anodes are suspended in a solution of sulphuric acid, and the copper is plated on to the cathodes. During this plating operation, the gold, silver, arsenic, iron, and small amounts of rarer metals and other impurities fall to the bottom of the tank in the form of sludge. This sludge is later refined and the valuable metals reclaimed.

The copper cathodes produced by this method are very pure, and will run about 99.98 per cent. Because the cathodes are rather brittle, they are not used commercially, but are melted up and cast into the forms which are adaptable to rolling mill and casting shop work. These forms are ingots, wedge cakes, wire bars, billets and some special shapes.

Impurities in Wire Bar.—The principal impurities found in the wire bar are shown in the following analyses by the United States Bureau of Standards, representing about 40 samples from various companies:

<i>Elements</i>	<i>Percentages</i>
Copper	99.91
Silver .....	.03
Oxygen .....	.052
Arsenic .....	.002
Antimony .....	.002
Sulphur .....	.002
Iron .....	.002
Nickel	Trace
Lead	Trace
Zinc	Trace

Arsenic is very injurious to copper for electrical purposes. Careful refining is necessary as .07 of 1 percent. of arsenic in copper will reduce its conductivity 25 percent. A proper percentage of arsenic tends to toughen and improve copper for other classes of work.

Wire Drawing, and Sizes.—Wire bars, which are used for drawing down to wire of various sizes, are usually long, of square cross section, tapering at one end to facilitate the passage through the master rolls of the wire mill. This is the first process of making wire. After several passages through

the rolls the copper is started through a series of dies in order to produce the smaller sizes of wire. While the wire is still large size, chilled iron dies are used, but, as the wire becomes finer, diamond dies set in steel must be substituted.

Sizes of copper wire are computed in Browne & Sharpe gauge; the finer the wire the higher the number of the gauge. For instance, No. 8 wire is very heavy, being of .1273-inch minimum diameter and .1298-inch maximum, while No. 40 is .003-inch minimum and .0032 maximum diameter.

Electrolytic copper, which is used for wire, is soft-drawn and comes in both bright and dull finish. The temper and finish is modified by means of annealing. Both the water and air process of annealing are used.

Wires for Insulation.—Usually when the wire is to be insulated with a textile such as cotton or silk, the dull finish is used, because the brighter, smoother wire does not permit the insulation to adhere so closely.

Copper wire which is to be rubber-covered is first tinned, by passing it through a solution of melted tin, and then wiping it clean with cotton or asbestos wicking. This coating of tin is so slight that the diameter of the wire is not perceptibly changed. Wire which is to be rubber-covered must first be tinned because the sulphur in the rubber has a chemical action on copper, but not upon tin.

Ordering Copper Wire.—The following is a typical specification for copper wire for manufacturing purposes:

1. All copper wire furnished must be of uniform diameter throughout, of circular cross section.

2. Conductivity must be equal to or greater than 98 per cent of the conductivity of the pure copper.

3. Wire heavier than No. 30 B. & S. gauge must be drawn within the limits of 1 per cent above and 1 per cent below the specified gauge.

4. Wire from No. 30 to No. 40 B. & S. gauge must be drawn within the limits of 1/10 per cent below or 1/10 per cent above the specified gauge.

5. Spools must be evenly wound and not overwound; the ends must be firmly fastened so as to prevent the wire contained from becoming loosened or uncoiled.

6. Each spool must contain one piece of wire only.

Lake and Electrolytic Copper.—Lake copper, as the name indicates, is produced by mines in the Lake Superior district.

During the last twenty years electrolytic has largely displaced lake copper for electrical work. Electrolytic is now conceded by many to be superior to lake copper in conductivity. The production of electrolytic copper now amounts to about 80 per cent of the total American production and from 70 per cent to 75 per cent of the world's production. When copper is referred to without qualification, the common understanding is that electrolytic is meant.

The standard specifications, approved February 18, 1910, provide that all wire bar and pig copper shall have a purity of 99.9 per cent, silver being counted as copper.

Sales to the Consumer.—A few of the producers sell the product of their own refineries only, and sell this direct to the consumer, while other producers sell not only their own product, but also act as selling agents for other refineries that do not sell direct to the consumer. Thus the Calumet & Hecla Co. sell the product of other lake companies of which it is a stockholder; the Anaconda Copper Mining Co., one of the big earning companies, now sell direct, although formerly it sold through the United Metals Selling Co. Phelps, Dodge sell the Calumet and Arizona brands, while the American Smelting & Refining Co. sell the output of the Utah, Nevada, Ray, Chino, and Tennessee mines. The commission rate for selling copper is usually 1 per cent. The large companies mentioned above are known to buyers of copper as "first hands," and the "second hands" are those that deal only on a brokerage basis.

Production Costs Vary.—It is difficult to secure definite data on the cost of producing copper, and it varies greatly with different mines, but it is generally conceded that the price of copper in 1920, approximately 13½ cents a pound, is under the cost of production in all but the most efficient mines. As usual during a receding market, the copper business has been none too brisk, and many of the big companies have been forced to sell copper at less than cost of production. The falling market makes it unprofitable for many of the mines to operate. This in turn curtails the supply, and will result in higher prices or lower costs.

Hot and Cold Rolled Sheets.—Sheet copper is produced by heating the wedge cakes or flat cakes to a temperature of approximately 900 degrees C., and reducing the thickness of the cakes by successive passes through the rolls. Finished

sheet copper is of two qualities, known as "hot rolled," and "cold rolled." Hot rolled copper is finished to size by rolling in packs, and performing the operation while the copper is hot. This gives a finished product which is not so accurate to gauge, and does not have the smooth, even surface of cold rolled. Cold rolled sheets are finished from about .150 inch by rolling cold and in single sheets. This produces the very best quality of copper sheet, which is used for spinning, wash boiler manufacture, reflector stock, engravers' plates, and the like.

Three Processes for Tubes.—Copper tubes are manufactured by three methods, the most common of which is the Mannesmann process. In this machine a solid copper billet is spun and pierced in such a way that a rough tube is formed. After this first forming operation, the piece is drawn on a plug and through a die until the size desired is obtained. Copper tubes are also made by casting large, hollow cylinders and gradually reducing these cylinders through dies until the finished size is reached. The third method is to cut a large, round disc from a sheet of copper, and then to cup it on a large punch press. These cups are passed through successive operations until they form long cylinders closed at one end. The closed end is then cut off and the cylinder so formed is drawn on a plug and through a die until it has reached the desired size.

Purity an Essential.—In order to fulfill its purposes in commerce, copper must be of the very highest quality. No copper in any form is accepted by the best manufacturers until it has been subjected to chemical and electrical tests. The purity of the material must exceed 98.90 per cent, and the electric conductivity must be over 99 per cent. Every step in the production of copper must be very closely checked by the most modern technical methods; the annealing of the material between successive operations must be accurately controlled, and the strength of the pickling solutions must be exact.

Brass an Alloy with Zinc.—Brass is an alloy of copper and zinc mixed in varying proportions. Commercial brass consists of mixtures varying from 95 per cent copper and 5 per cent zinc down to 60 per cent copper with 40 per cent zinc.

Brass is what is known as a "solid solution," i. e., the zinc

is so dissolved in the copper during the melting operation that in the finished product it is impossible to distinguish either copper or zinc under the finest microscope. To illustrate, take a cup of hot water, add a teaspoonful of sugar, and stir the mixture until all the sugar is dissolved. When cooled, we have a clear liquid in which it is impossible to see any sugar. This is the way zinc is dissolved in copper.

Lead and copper do not alloy in this way, but form what is known as a mechanical mixture. As an example of this, let us take a cup of hot water and a teaspoonful of sand. If we stir the sand thoroughly it becomes disseminated throughout the water, but if we cease stirring and permit the mixture to stand for a few moments, the sand will immediately settle out to the bottom of the cup. The only way we could hold the sand evenly distributed throughout the water would be to freeze the mixture at the exact moment it was well stirred.

Many Varieties of Brass.—As stated before, common brass contains only copper and zinc, but for special purposes, other materials are added to the brass. Lead is added to give free cutting qualities; tin is added so that the material will resist corrosion, and to increase the hardness when rolled; nickel is added to produce the well known white metal, "nickel silver."

It is impossible in the space available to list the many qualities which may be obtained by changing the mixture and the temper of brass, in order to best adapt it to special uses.

Profit by Experience.—Each problem that presents itself to the manufacturer should be taken up in detail with the brass maker in order to profit by his experience and to secure aid in drawing up the specifications for the material desired. Even in a given alloy, the tempers which may be obtained are numerous, and each one is best suited for a certain purpose.

For example, sheet brass may be obtained in reflector anneal, light anneal, drawing anneal, soft anneal and dead soft anneal; cold rolled temper, quarter hard, half hard, hard, extra hard, and spring. For some purposes common hard brass in one of the above tempers may be entirely satisfactory; at other times a mixture richer in copper may be necessary, so that the sheet metal will withstand drastic drawing operations, and will not show a tendency to "season crack."

"Season Cracking" Explained.—"Season cracking" is a defect which should be thoroughly understood by all users of

brass. A more proper expression might be "corrosion cracking," because "season cracking" is not possible without corrosion. The cause of the troublesome defect is as follows: When the sheet metal is drawn unevenly, a condition of strain is set up in the metal. If metal in this condition is placed in an atmosphere of corrosive gas, or is attacked by any corrosive solution, the surface of the material becomes etched, and thin spots develop. As this corrosion progresses, the strains in the metal become greater than the tensile strength of the metal in the thin spot, and rupture follows.

It is of the greatest importance that the brass mill should know for what purpose its materials are being used. The close coöperation between purchasers and manufacturers would eliminate many present day troubles.

New Uses for Copper and Brass.—During the war, when prices were high, steel came into use for many of the parts previously made from copper and brass; but now that prices are seeking their normal level, there seems to be again a tendency to use copper and brass for many purposes, both old and new. The ease with which they are worked, and their resistance to rust, are characteristics much in their favour. We believe that, with the realization of all the benefits to be obtained, there will be a constantly increasing market for copper and brass materials.

The reported discovery of a new method of tempering copper for tool and die work opens up a new and very interesting and profitable field for the producer and consumer of copper and brass and their alloys.

CHAPTER XXI

PURCHASE OF MACHINERY AND MINE EQUIPMENT¹

Quality Must Come First.—In buying machinery and supplies for a mining company, whether the product be copper, iron ore, lead, zinc or some other metal, the two prime considerations are the quality of the goods and the reliability of the vendor. After these come price considerations.

The experiences of buyers for the large mining companies of the country prove that the best article of any kind, whether the cheapest or not in price, is the only one to consider. It must not be inferred that little attention should be paid to price. On the contrary, the amount paid each year for equipment and supplies is a very important factor in the unit cost of production, but the quality of the material must come first. Mining companies do not buy raw materials for resale, but *for their own use*, and the question of replacement is one that they cannot afford to have come up very often.

Making sure that the source of supply is reliable should become a matter of routine, but many buyers often neglect or lose sight of this matter. Only when they find it necessary to file claims for shortages, imperfect packing, delays of various kinds, and the like, is that class of purchaser brought to a realization of the importance of reliability. This phase of the purchasing agent's work is brought out prominently in buying heavy machinery for mining work. Here no chances can be taken. Mistaken economy may cause great losses in time, money and in lives.

It would be impossible to cover in one chapter, the whole field of the purchase of mine machinery, so only three of the principal classes will be discussed here; namely, rock drills, to break up the rock; hoisting engines, to raise it to the surface; and lathes, to keep up repairs.

Rock Drills.—As one manufacturer of rock drills says, "The art of drilling rock has reached such a state of efficiency that the manager of a project involving different kinds of work usually employs a different type of drill for each kind." The

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Ingersoll-Rand Co., of New York City; the Sullivan Machinery Co., of Chicago, and the Denver Rock Drill & Manufacturing Co., of Denver, all of which have offices in the principal cities of the world, are three of the most prominent manufacturers of rock drilling machinery. The purchaser may safely entrust his problems with them, or for that matter, with a number of other like concerns; for it is neither satisfactory nor profitable to sell a drill unsuited to the work in hand. Improvements are continually being made on rock drills, just as on other kinds of machinery. Some of the factors to be considered in the purchase of rock drills are as follows:

1. *The Nature of the Work to Be Performed*, i.e., whether sinking, drifting, raising or stoping. It also makes a difference whether the holes are to be drilled in copper-bearing rock, like the conglomerate or amygdaloid veins of Lake Superior, or in rock carrying silver, lead or zinc. When sinking, it will often be found preferable to use a heavy type of drill that is set up on a tripod, rather than the lighter drills commonly used in stoping, raising or drifting, which are set up on posts.

2. *Speed of Drilling*.—This depends usually on whether the cost of operation or the time element is forecast. If the work is in a mine producing 12 months in the year, the machine that will drill the most footage at the lowest cost will probably be selected. On the other hand, if the job is a tunnel which must be completed within a certain time, then cost will be placed secondary to speed.

3. *Cost of Upkeep*.—The value of a drill depends to a great extent on the number of times per year it must be brought up to the surface for overhauling or repairs, or rather, upon the rarity of the occasions. This doesn't mean much in an open pit or a shallow mine, but it does mean something when the drill must be carried through a drift several thousand feet to the shaft, and then up from 5,000 feet to 6,000 feet, as is common in many copper mines.

4. *Weight of Machine*.—Until recent years the common rock drill weighed between 300 and 400 lbs., making it a two-man job to handle and operate. Now this weight drill is seldom seen, as the one-man machine of 90 to 150 lbs. has taken its place. As the smaller machines will drill just as many feet as the larger type, the saving in labour of handling is important.

5. *Simplicity of Operation.*—A man may be an expert miner, but a poor mechanic. Therefore, the drill that is made of the smallest number and of the simplest parts will appeal to the operator, as it is less liable to get out of order and interfere with his earning capacity.

6. *Opportunities for Demonstration.*—Most manufacturers will gladly demonstrate their drills by placing one or more in the service of the operator. The results so obtained, plus the criticisms and suggestions from the mine superintendents and efficiency men, prove of much value to all concerned. Manufacturers of rock drills will usually meet the prospective purchaser more than half way in matters of this kind.

Hoisting Engines.²—No part of a mine's equipment is of greater importance than the hoist. For development work, or for sinking the first few hundred feet from the surface, any standard hoisting engine of 12 to 100 horse power, such as those used by building contractors and quarrymen, will serve. These may be of single drum or double drum type, with boiler attached, or power may be supplied from a central station.

There are a number of concerns, like the Nordberg Manufacturing Co. and the Allis-Chalmers Manufacturing Co., both of Milwaukee; the Lidgerwood Manufacturing Co., of New York City, and the American Hoist & Derrick Co., of St. Paul, that make specially designed hoists for hard service and for handling by unskilled operators.

But when the shaft gets to a depth of 2,500 feet or more, the conditions are generally such as to warrant a special hoist. As it is improbable that any two hoisting problems will be exactly alike, the selection of the proper equipment calls for special engineering knowledge.

Complete Understanding Necessary.—Most mining companies, and by this term is meant those producing copper, iron ore, lead, zinc or any other metal (not coal), have on their staff a mechanical or consulting engineer, who will assist the buyer in solving these problems. A complete understanding of the various details involved should be reached before a hoist installation is selected. All the data should, of course, be cleared through the purchasing department.

Assuming that the buyer has been requested to start negotiations for a hoisting engine for a permanent installation, the

² Much of the technical data in this section of the chapter was obtained from bulletins published by the Nordberg Manufacturing Company and Allis-Chalmers Manufacturing Company, both mentioned in the next paragraph.

first step is to submit to the manufacturers a preliminary data sheet something like the following:

PROPOSED HOISTING PLANT

1. Customer
2. Location
3. Type of hoist, steam or electrical
4. Geared or first motion
5. Single or double drum
6. Load {
 Weight of skip ..
 " " cage ..
 " " car ..
 " " ore ..
 " " rope ..}
7. Average speed desired
8. Shaft {
 Vertical or inclined ..
 Degree of inclination from horizontal ..
 Single or double compartment ..
 Size of compartments ..
 Present depth ..
 Ultimate depth ..}
9. Size and kind of rope to be useddia.....strands.....wires.....
10. Cages—In balance or independent
11. If in balance, will hoist ever be called upon to operate unbalanced? If so, for how long at a time or for how many trips consecutively will it be necessary to operate unbalanced?
12. Type of clutch desired
13. Type of brake desired
14. Corliss or slide valve
15. Steam pressure available at engine
16. Electric current available at motor {
 Alternating or direct ..
 Voltage ..
 Phase ..
 Cycle ..
 Time in operation ..
 Time required to load or unload ..
 Time of stop between hoisting periods ..}
17. How far will hoist be located from center of shaft?
18. How high will head sheaves be above center line of hoist drums?
19. Will hoist be located towards side or end of shaft?
20. Remarks

When one goes to a physician for consultation, there is nothing to be gained by keeping back information bearing on the case, for the professional man usually needs it to make a correct diagnosis. So in giving the preliminary data regarding the new hoisting plant, all the information available should be freely given the prospective builder. The reasons for most of the questions given above are self-evident. A few words in connection with some of the others may not be amiss.

Question 4.—Geared, or First Motion.—Many companies prefer a geared hoist, especially for the hoisting and lowering of men and supplies. In Michigan the law requires that the maximum speed when hoisting men shall not exceed 1,200 feet per minute. When hoisting rock or ore, the speed may go to 2,500 or 3,000 feet per minute. While high speed may be obtained with a geared hoist, if speed is essential the first-motion machine should be specified. The question of gearing will naturally come up if the hoist is to be run by a motor.

Question 5.—Single or Double Drum.—It may be desired to use one engine to hoist from two shafts, in which event two drums will be required, as one must be thrown out of gear while the other is serving its shaft. The second drum may be used instead for winding the rope attached to the balance weight, car or cage. This device was adopted a few years ago, and is referred to under Question 10.

Drums may be cylindrical or conical. The former is generally used, but at great depths the weight of rope often equals or exceeds the weight of ore, and in order to decrease the starting movement and cylinder sizes, where hoisting can be done in balance, a special type of drum with conical ends and cylindrical center portion is often specified. This type of drum has proven very successful, especially in the mining section of northern Michigan. One engine builder alone has in service about 40 hoists fitted with this type of drum for depths of 3,000 to 7,000 feet.

Question 9.—Size and Kind of Rope to Be Used.—This is one of the most important questions to be decided in connection with the hoisting engine. For instance, the following differences will be found in standard $1\frac{1}{4}$ -inch diameter 6 x 19 ropes, i. e., ropes made of six strands and a hemp centre, nineteen wires to the strand, although the weight of the rope per foot is the same in each instance, namely, 2.45 lbs.:

	<i>Iron</i>	<i>Cast Steel</i>	<i>Extra Strong Cast Steel</i>	<i>Plough Steel</i>
List Price.....	40c.	46c.	56c.	65c.
Approximate strength in tons of 2000 lbs.....	22.8	47	53	58
Proper working load in tons of 2000 lbs.....	4.56	9.4	10.6	12

If it is desirable to have a rope of greater pliability than those indicated, it can be obtained by increasing the number of wires; making the rope six strands of thirty-seven wires each, or eight strands of nineteen wires each, wound around a hemp center. In these extra pliable ropes the wires do not have as large an area as in ropes of standard 6 x 19 construction, nor will they stand abrasion as well. The best engine in the world will be valueless if the proper rope is not used, even if the factor of safety only is considered.

Question 10.—*Cages, in balance or independent.*—As already noted, the hoist may have two drums, one for the cage or skip, and the other for a balance weight, car or cage. Or one drum only may be used, and the two cages; or the cage and the balance, may be wound on this drum. If it should ever be necessary to operate one cage at a time, or unbalanced, provision must be made for power sufficient to hoist the maximum load.

Question 11.—*Type of Clutch Desired.*—Clutches are of various types to meet different conditions. For instance, there is the multiple tooth clutch, with the driving and driven members made of cast steel, each having cut teeth which are accurately machined to insure equal distribution of pressure in the teeth. The driven member is fastened to the drum spider. The driving member slides on the shaft, and revolves with it. Sometimes the hub is machined hexagonally and slides on a hexagonal portion of the shaft, which is enlarged a trifle over the shaft diameter, while in other cases the hub is bored out and feather keys are used for driving.

Then there is the improved Lane friction clutch, which consists of a spider keyed to the drum shaft, a fixed and a movable arm, a friction band, and a sliding sleeve. One may specify the Brown heavy duty multiple arm friction clutch, which consists of a driver keyed to the drum shaft, two ribbed rings to which friction blocks are attached, toggle levers for the rings, a steel clutch ring fastened to the drum and a sliding sleeve. This is a very powerful clutch, and operates equally well for either direction of rotation. Finally, there is the axial plate clutch, which consists essentially of two heavy rings lined with basswood, which grip a ring bolted to the brake ring. The two clutching rings are supported on heavy driving spiders by pins which allow free movement of the rings in an axial direction. The clutching rings are moved by toggles carried by the driving spider, and operated from a sliding collar and yoke on the shaft. The construction is such that the toggles, when set, pass over center and lock the

clutch in position, so that there is no strain in an axial direction, tending to disengage the clutch. This is a very efficient type. The plate clutch has one advantage over the band type, in that the rope can lead off the drum in either direction, while in the latter type it must lead off in one direction only.

Question 13.—*Type of Brake Desired.*—Brakes are either the band or post type. Very few, if any, manufacturers recommend the band type, because they cannot be applied or relieved uniformly; neither are they as safe as the post or under brakes, because the stresses are high, and the entire maximum stress must come upon one pin. For smaller hoists, either steam or electric, the post type brakes are hand operated, with a hand wheel and screw, or with a lever and quadrant, as desired. For larger hoists, the brakes are of the gravity type, operated by thrust cylinder, using either steam, air or oil under pressure, the brake being applied by a fixed weight and relieved by the thrust cylinder.

The prospective purchaser will want to go into the details of these types of brakes very thoroughly, as they are a very important part of the machine.

Questions 17-18-19.—These questions have special importance in connection with the location of the head sheaves, especially in shafts having two or more compartments.

Within the past few years a device for keeping hoisting engines under control has been placed on the market. This apparatus is guaranteed to control all types and sizes of steam, air and electric mine hoists, preventing overspeeding and overwinding in hoisting and lowering, yet it does not subject the hoist to a dangerous shock or jar.

The mechanism is set to keep the engine from hoisting over a certain speed, begins to slow it down when the skip or cage is within 400 feet, or whatever other distance may be desired, from the dump, and automatically stops the engine if an over-hoist is made. There is no doubt that all new mine hoists, especially long-hauling ones, will be equipped with this kind of device in the future.

Lathes.—No machine shop is complete without one or more lathes. In fact the lathe is sometimes called the universal tool, because it is the oldest, the first developed, and the most important of all machine tools. The screw cutting engine lathe is the machine from which all other machine tools were developed.

In "How to Run a Lathe," a booklet published by the South Bend Lathe Works, South Bend, Ind., we find these statements: "It was the lathe that made possible the building of the steamboat, the locomotive, the electric motor, the automobile and all kinds of machinery used in industry. Without the lathe, our great industrial progress of the last century would be impossible."

The buyer of a lathe, or any machine tool for that matter, will not find it necessary to go very far to obtain his machine, for there are many manufacturers of all kinds in the United States. Further, it might be kept in mind that this country leads the world in the production and quality of these machines, and the names of prominent American-made tools are almost as well known in the principal industrial sections of Europe as they are in the United States.

Repair Work of Chief Importance.—Mining companies as a rule have plenty of space on their properties, so consideration of the location of a lathe in planning the layout of the machine shop is one feature that does not concern them very seriously. Neither are they as much interested in a machine that will produce a certain amount of work, as they are in obtaining the proper outfit for the repair work which comes to the shop daily. The smaller type of lathe, say that having about a 16-inch swing, will take care of the repair work on the rock drills. When it comes to repairing one of the hoisting engines, turret lathes or gun lathes are necessary.

"Universal" would seem to be an appropriate name for a lathe, because so many kinds of work may be done on this machine. If space, money, or quickness of delivery of a new machine are factors, the buyer will find it to his advantage to concentrate his efforts on securing some type of lathe. They take up no more room than other machine tools and cost no more. Furthermore there are so many manufacturers of this type of machine that a reasonable delivery could be obtained from some one of them. While the drill press limits the work to drilling, the boring mill to boring, and the planer to planing or shaping, all these, to a limited degree, may be done on a lathe, in addition to many other kinds of work, such as turning, threading, knurling, milling, etc., for which the machine is intended.

The buyer will find that manufacturers of lathes, as well as

the jobbers of such machines, will be more than anxious to meet the purchaser half way and help him to decide just what machine is best suited to his work.

Pointers for the Buyer.—While the successful buyer for a mining company must have at least a general knowledge of rock drills, hoisting engines and machine tools, it is rare indeed that the buyer is an expert in any particular line. He may know all that is necessary to buy to the best advantage the general run of supplies, such as packing, hose, lumber, belting, iron and steel products, etc., and as a rule the buyer for the average mining company is given free rein, but when it comes to obtaining the classes of machinery mentioned in this article, he will find that these two rules should be followed to obtain the best results:

1. Have a complete and definite understanding with your underground superintendent, the superintendent of motive power, or foreman of machine shop, regarding the rock drill, hoisting engine or lathe you will require:

2. Be perfectly frank in your negotiations with the prospective seller, in order that he may feel free to acquaint you with all the peculiarities of his product, and make sure his engineers and yours are in accord regarding the different characteristics of the machine in question.

In this summing up, no mention is made of price. It is understood, of course, that the cost will be a factor, but that it is secondary to the selection of the article which is best suited to the job in hand.

CHAPTER XXII

COAL FOR STEAM OR HEATING¹

Object of the Coal Buyer.—The sole object of the coal buyer is to secure the greatest number of heat units, at the lowest total cost, in the form best adapted to a certain power plant. The first step is, therefore, to determine which coal contains the greatest number of heat units per ton or per pound. By referring to Bulletin No. 123 of the Bureau of Mines, pages 17 to 131, or better yet to the "Coal Catalog," you will find a statement of the number of heat units in coal from every district. For your preliminary investigation, all other factors may be disregarded.

After you have selected those with the greatest heat value and set them down with their laboratory numbers, location, and B. T. U.² in parallel columns, the delivered price per ton should be added to the next column, and the delivered price per thousand B. T. U. set down in the next column. Any reliable dealer can quote the approximate delivered cost, and the cost per M. B. T. U., can easily be figured. The next step is to eliminate the least desirable coals.

As you eliminate each sample from your calculations, the reason for this elimination may be set down in the last column to the right. This will afford a permanent record of the reasons for each elimination.

Hauling Costs a Factor.—As the freight charges are a very large element in the total cost of coal, many of the most distant coals must first be eliminated. You can hardly afford to use either Pennsylvania or West Virginia coals for making steam in Illinois.

If ashes must all be moved by hand and hauled away by truck, you will next eliminate those samples which are unduly high in ash. If, on the other hand, the ashes are all handled automatically, and disposed of without cost, you may better

¹This chapter and the two following chapters were written with the coöperation of Charles A. Lind, Fuel Agent of the Commonwealth Edison Co., of Chicago.

²B. T. U., the abbreviation for British Thermal Unit, is the quantity of heat required to raise one pound of water one degree Fahrenheit.

afford to buy coal containing 20 percent. ash and 10,000 B. T. U. costing \$3 per ton delivered, than coal containing 10 percent. ash and 10,000 B. T. U. at \$3.50, because the B. T. U. is the number of B. T. U. in a pound of coal, and not the number of B. T. U. in a cubic foot or a cubic yard. If the heat units are in usable form, the extra volume of ash simply acts as a harmless filler.

Storage Points.—If you are so situated that it is necessary to store coal for any length of time, you will next eliminate those samples which are high in moisture and high in sulphur. Coal containing a high percentage of moisture disintegrates rapidly and tends to spontaneous combustion, and a high sulphur coal also aids spontaneous combustion. If, however, you have a modern underwater storage system, this objection will not hold.

High and Low Volatile Coal.—If your combustion chambers are constricted, or if you must avoid excessive smoke, it is well next to eliminate those coals which run high in volatile, because it is the volatile matter which is discharged from your stack in the form of smoke. If your plant is not equipped to burn all the volatile matter in the coal you select, all that is not burned is a loss. A smoking stack always means imperfect combustion, due to the wrong kind of fuel for that plant, or to wrong handling in the plant. The proper combustion of high volatile coals requires large combustion chambers and careful handling.

Adequate Transportation a Vital Factor.—The importance of adequate transportation facilities can hardly be overemphasized. If the mine upon which you depend is at one end of a short, direct route, and you are at the other end, you profit in many ways. The amount of coal in transit and, therefore, the amount of money so tied up, is greatly lessened. Stop orders are effective more promptly and you begin to receive coal quicker after the resumption of shipments. This also greatly reduces the liability of accumulating demurrage charges.

Where shipments originate upon intrastate railroads, peculiar complications sometimes ensue. Several years ago a short intrastate railroad in Indiana which depended almost entirely upon coal for its revenue went into receivership. It happened that the judge who acted as receiver knew little about railroad management, but did not want anyone to tell

him how he should run his business. His first idea was to reduce the rates in order to build up the volume of business, and under the regulations then in effect he had full authority to change the rates whenever he chose. It was rather a dull business year when he reduced the rates, and coal was not much in demand. The rate cut was not made until after most coal contracts were signed, and the net result was a cut in revenue per ton mile with no marked increase in the volume of business.

Juggling Freight Rates.—After watching the consistent shrinkage in net receipts for a few weeks, the receiver increased the rates again. If he had only put them back to the old basis, not much harm would have resulted. In an attempt to recover all the ground he had lost because of the former reduction, however, he boosted the rate 35 cents higher than it had been before.

The net result was an almost complete shutdown of all the mines on this road, as the coal buyers could not pay the increase in freight rate, and the operators could not absorb the 35 cents per ton, or any large part of it. Coal was then selling at about one dollar a ton at the pit mouth. This peculiar situation indirectly led to the discovery of some remarkable coal thefts which are referred to further on.

The Final Choice.—You have now perhaps narrowed your choice of coal samples to three or four, and your final decision will depend very largely upon the net result of your test runs. Often coal from two mines in the same district will act differently under actual firing tests.

In many modern plants it is possible to determine with accuracy the total cost of producing one pound of steam with various kinds of coal, and under varying conditions. A careful test of a large number of samples, even then, is often unduly expensive. If you know that any particular coal contains more heat units than the one you have been using, and if your firing tests show that the furnaces will use this coal as efficiently as the other coal; if your ash handling cost is not increased, and if the delivered cost for 1,000 B. T. U. is less, you are usually safe in contracting for that particular kind of coal. Unfortunately, there are so many variables in the problem that it is extremely difficult to prove a saving of any certain number of dollars in the purchase of coal for most industrial power plants.

Carelessness, Theft.—When coal is delivered to your plant from a distant team track, dishonest practices are apt to crop up. If the coal is handled through a coal yard, and all trucks are weighed at both ends of the route, about the only way the buyer can be defrauded is through collusion between truck driver and weighmaster. If there is collusion, only part of the load may be dumped, and the rest driven off and sold. This, however, would hardly pay for the trouble and the risk involved. But the weighmaster may sign for loads of coal which leave the coal yard, yet never reach your plant. An automatic timer and weight registering device on your scale will prevent this theft, and will also prevent the falsifications of the weight of each load.

When there is no such protecting device it is a fairly simple matter to "fudge" the weight of each load, and the weighmaster may sign for various loads which he does not receive. There is still the possibility that coal may be properly weighed, and then dumped in the next block, and the empty coal truck properly reweighed. The only safe check is occasionally to have the loads turned back for reweighing, and to install an independent observer to make a check on the operation of your scales. In one case in Indiana this double check proved a shortage of more than one hundred tons of coal in three days.

In order to carry on thefts of this kind, the coöperation of at least one teamster is necessary, and the teamster soon becomes careless and the theft is detected. Where the power plant is located on a switch track the installation of a railroad scale makes it possible to check coal deliveries easily, and the total labor of weighing a given lot of coal is so much less that a higher type of employee may profitably be assigned to this duty.

How a Shortage Was Discovered.—The discovery of the particular shortage of 100 tons of coal in three days was, in part at least, due to the peculiar freight situation already referred to.

The 35 cents extra freight rate was still in force when new coal contracts were being negotiated. The factory owner knew the various price factors in the bid submitted, and knew that the gross margin of profit was 25 cents. There was every probability that the extra burden of 35 cents would be with-

drawn, but there was no definite assurance that it would not remain in effect for six months.

The contractor was, however, willing to close the new contract on the same basis as the contract of the year before. In other words, he was willing to risk a loss of 35 cents per ton when his legitimate gross profit was only 25 cents per ton. He was not only willing, but anxious to close the contract on that basis. Because of this fact the factory owner became suspicious, and began the investigations which disclosed the loss referred to.

As soon as his suspicions were aroused he had, however, ordered in a huge reserve stock, with the result that he held coal worth several thousand dollars, the bills for which were still unpaid, when he preferred charges against the contractor. It is much easier to settle a claim when the other party is in the wrong, and you owe him for the goods delivered.

Ash Fusing Point.—For certain types of high pressure boilers, the fusing point of the ash is of prime importance. If you are operating a travelling grate you will need coal with a high ash fusing point, as the fusing of the ash will tend to clog the efficient operation of the grate. If, however, you are using underfeed stokers, the efficient operation depends upon a low fusing ash, because all ash must be pulled out of the front of the furnace.

If the ash fuses into a great clinker, it is easily removed without letting the steam down. The ash which does not fuse into a clinker, but remains in small bits, or runs like molasses, not only places an undue burden on the firemen, but the length of time required to clean the furnaces adds to the smoke, and causes the loss of a great amount of heat because of the open furnace doors.

Long Ton and Short Ton.—Most people mean 2,000 pounds when they speak of a ton. Most Government offices and some private business firms use the long ton (2,240 lbs.), however. Many firms have lost a great deal of money because they agreed to sell at so much for 2,240 pounds when they meant to bid that figure for 2,000 pounds.

Dry and "as Received" Samples.—As the term implies, the analysis of a sample of coal "as received" means as it was taken from the mine, car, or waggon. The dry basis is the analysis after all the moisture has been removed by placing the sample in a drying oven. The percent. of ash in a dry

sample is, of course, larger than in the same sample "as received" and there are more B. T. U. in a pound of dry coal, than in a pound of the same coal "as received." The formula for transposing dry B. T. U. to the "as received" basis is as follows:

TO TRANPOSE B. T. U. ON THE DRY BASIS TO B. T. U. AS RECEIVED:

Multiply B. T. U. by 100 less the moisture content, i.e.
 $12214 \times (100 - 9.94) = 11000$ B. T. U. as received.

TO TRANPOSE B. T. U. AS RECEIVED TO DRY B. T. U.:

Divide the B. T. U. by 100 less the moisture, i.e.
 $11000 \div (100 - 9.94) = 12214$ B. T. U. dry basis.

An excellent method of sample taking and analysis is given in Bulletin No. 123, U. S. Bureau of Mines, from which the quoted matter following is reprinted. Technical Paper No. 8, and Bulletin No. 22, issued by the Bureau of Mines, may also be consulted to advantage.

SAMPLE TAKING AND ANALYSIS

The method of collecting mine samples by the Bureau of Mines involves selecting a representative face of the bed to be sampled; cleaning the face; making a cut across it from roof to floor, and rejecting or including impurities in this cut according to a definite plan, as they are included or excluded in mining operations; reducing this gross sample, by crushing and quartering, to about three pounds; and immediately sealing the 3-pound sample in air-tight container for shipment to the laboratory.

Collection of car samples.—The carload lots of coal shipped to Pittsburgh for test were sampled by taking definite quantities of coal at regular intervals from a car as it was unloaded, and by reducing to convenient size (about 50 pounds) the gross sample thus obtained. The method of collecting and reducing car samples is given in detail in Bureau of Mines Bulletin No. 116.

Preparation of laboratory samples.—Immediately after the sealed 3-pound can in which the sample is received at the laboratory has been opened, the contents are transferred to a weighed sheet-metal pan, spread out to a depth of 1 inch, and at once weighed. The pan containing the sample is placed in a large drying oven in which a temperature of 30 to 35 degrees C. is maintained.

Through this oven a current of warm air is made to flow by means of an ordinary desk fan mounted on top of the oven, and the sample is dried until the loss in weight between two successive weighings, made 6 to 12 hours apart, does not exceed 0.5 percent. The total loss of weight is reported as "air-drying loss."

Determination of moisture.—The residual moisture in the air-dried sample is determined by heating 1 gram in a shallow porcelain capsule, seven-eighths of an inch deep and $1\frac{3}{4}$ inches in diameter, for one hour at 105 degrees C. in a constant temperature oven, through which a current of dry preheated air is rapidly passing. The air is dried by being passed through concentrated sulphuric acid. The covered capsule is cooled in a desiccator over sulphuric acid and then weighed. The loss in weight is called "moisture at 105 degrees" in the air-dried coal.

Ash determination.—The same sample is used for determining ash as was previously used for determining moisture. A porcelain capsule containing the sample is placed in a cool muffle and the temperature gradually raised to approximately 750 degrees C. The ignition in the muffle is continued, with occasional stirring of the ash, until all particles of carbon have disappeared. After the capsule containing the ash has been cooled in a desiccator it is weighed, and ignition is repeated until constant weight (0.0005 gram or less) has been attained.

The ash content as determined by the method represents the ignited mineral residue or "uncorrected ash."

Determination of volatile matter.—A 1-gram sample of the fine (60 mesh) coal is weighed into a bright well-burnished, 10-gram (10 c.c.) platinum crucible (a) with a close-fitting capsule cover (b) the crucible and contents are heated to a temperature of 950 degrees C. in a specially designed electric furnace of the vertical type. After having been heated exactly seven minutes, the crucible is removed from the flame, cooled, and weighed. The loss in weight minus the weight of moisture determined at 105 degrees C. times 100 equals the percentage of volatile matter.

Determination of fixed carbon.—The fixed-carbon content of the sample is determined by calculation—by subtracting the sum of the percentage of moisture, ash, and volatile matter from 100.

Sulphur determination.—Sulphur is determined by the Eschka method. A 1.3737 gram part of the air-dried coal is mixed with 6 grams of Eschka mixture in a No. 1 porcelain crucible and gradually heated in a muffle, with free access of air, until all the carbon has been consumed. The sulphur is extracted with hot water, completely oxidized to sulphate with bromine water, and precipitated and weighed as barium sulphate.

Determination of calorific value.—The heat of combustion is determined with the bomb calorimeter. One gram of the air-dried coal is completely burned in compressed oxygen gas and the total heat evolved is absorbed in a weighed quantity of water in which the bomb is immersed. The rise in temperature of the water is measured with a thermometer that is graduated in hundredths of 1 degree C., and can be read, by means of a cathetometer, to 0.002 degrees C.

Corrections are made for "radiation losses," oxidation of nitrogen to aqueous nitric acid, and oxidation of sulphur dioxide to aqueous sulphuric acid. The calorific value obtained in this manner is the total heat of combustion with water vapour condensed to liquid water at the temperature of the calorimeter, that is, 20 degrees to 25 degrees C.

Interpretation of analytical results.—The coal analyses reported in this bulletin are grouped in the usual manner, as follows:

1. The proximate analysis, including results of determinations of moisture, volatile matter, fixed carbon, and ash.
2. The ultimate analysis, including results of determinations of carbon, hydrogen, nitrogen, oxygen, sulphur and ash.
3. The calorific value, heating value, or heat of combustion.

For many of the samples the analysis is given for three conditions, as follows: (1) As received at the laboratory, (2) computed to a moisture-free condition, and (3) computed to a moisture-free and ash-free condition.

At mines where two or more samples were taken, and a composite sample obtained by mixing equal portions of the separate samples, the analysis of the composite sample is given for the three conditions, because presumably the composite sample represents the coal in the mine better than any one of the separate samples.

The analysis of the sample "as received" (condition 1) represents the actual sample as received at the laboratory and, as for a mine sample, represents the

coal at the point of sampling in the mine. The "moisture-free" analysis (condition 2) represents the relative composition and heating value of the dry coal; this form of analysis is convenient for comparing similar coals of variable moisture content.

The "moisture-free and ash-free" analysis represents approximately the relative composition and calorific value of the dry organic or combustible matter. This form of analysis is only an approximation, because the ash does not have the same weight as the inorganic or incombustible matter in the coal. However, the error does not exceed 1.5 per cent in comparing coals that do not vary much in the character and amount of ash and sulphur.

Domestic Coal Screenings.—Many coals are suitable for domestic purposes, although the screenings from those coals are practically valueless. For instance, Brazil Block from Brazil, Indiana, is excellent for domestic purposes, but the screenings are made up very largely of impurities.

SMOKELESS COALS

Principal Groups.—There are two principal groups of smokeless coals, the anthracite and the Pocahontas groups. Small areas of anthracite occur in the West, but generally these coals have been converted to anthracite by the heat of some mass of igneous rock that was thrust into the other rocks while it was in a moulten condition. Many such masses take the form of thin sheets which were forced in between the beds of the other rocks, and consequently for some distance they may lie parallel with the coal beds. If a coal bed is cut by the igneous rock, it may be burned to ashes, made into coke, or converted to anthracite. The product will depend on the presence of air, the intensity of the heat, and the length of time the coal was subjected to the influence of the heated mass.

Value of Anthracite.—Anthracite is an almost ideal domestic fuel, but it is not well adapted to steam raising unless an absolutely smokeless coal is needed. Many people believe that anthracite has greater heating value than any other coal. That is not true. Largely on account of its low heating power and its relatively high cost, anthracite is not an economical fuel for steam raising or for use in general manufacturing.

Average B. T. U. per pound of anthracite coal

Northern coal field,	13160
East Middle coal field	13420
West Middle coal field	12840
Southern coal field	13220

The average fuel ratio of anthracite (fixed carbon divided by the volatile matter) is not more than 50 or 60, and not less than 10.

Semi-Bituminous.—The most widely known semi-bituminous coal is the "Pocahontas" coal mined in McDowell county, West Virginia. The name "semi-bituminous" is really a misnomer; the term should be super-bituminous, because this coal is of higher grade in every way than bituminous. The fuel ratio (fixed carbon divided by volatile matter) ranges from 3 to 7. Its relatively high percentage of fixed carbon makes it nearly smokeless when it is burned properly, and consequently most of these coals go into the market as "smokeless coals."

Best for Steam and Heat.—The best coal of this type has a heating value greater than that of any other rank or grade, and is consequently best adapted to raising steam and to general manufacturing that requires a high degree of heat. It is regarded as the best coal for steamship, and especially for naval use, as it is nearly smokeless, and requires less bunker space per unit of heat than any other coal. The coal is generally minutely joined and is, therefore, tender and friable. In fact, it is so friable that in mining, a large percentage of fine coal is produced, and in transportation, many of the lumps are broken to pieces, so that by the time it reaches the consumer, especially if it has been trans-shipped, it is generally in small pieces.

COAL VALUES TABULATED

Average Theoretical B. T. U. per pound of semi-bituminous coal

Broad Top, Pa.	14820
Clearfield, Pa.	14950
Cambria, Pa.	14450
Summerset, Pa.	14200
Cumberland, Md.	14400
Pocahontas,	15070
New River,	15220

Coal arranged according to rank—hardness

1. Lignite
2. Bituminous
3. Semi-bituminous
4. Semi-anthracite
5. Anthracite

Coal arranged according to grade—heat value

1. Lignite
2. Bituminous
3. Semi-anthracite
4. Anthracite
5. Semi-bituminous

STEPS IN THE PURCHASE OF COAL

1. List samples in Bulletin No. 123 that have highest heat value. (See last column.)
2. Set down opposite each the delivered price per 1000 B. T. U.
3. Eliminate those which are unduly expensive.
4. Eliminate those with a high ash content if your ash disposal method is expensive.
5. Eliminate those which run high in sulphur and high in moisture if you must store this coal.
6. Eliminate those which run high in volatile matter if you must keep down the smoke.
7. Eliminate those which have the poorest transportation facilities.
8. Run seven day tests on the remaining samples in order to determine which coals are best suited to your special plants, watching the action in the furnace.
9. Select the coal which is best suited to your conditions and which will give you the lowest total cost per thousand horse power.

Other pitfalls.—The purchasing agent buying coal must have these points in mind:

1. Intrastate Railroads.
2. Fusing point of ash.
3. Dishonest employees.
4. Long ton.
5. Dry B. T. U. and B. T. U. as received.
6. Analysis of samples selected.
7. Brazil Block.

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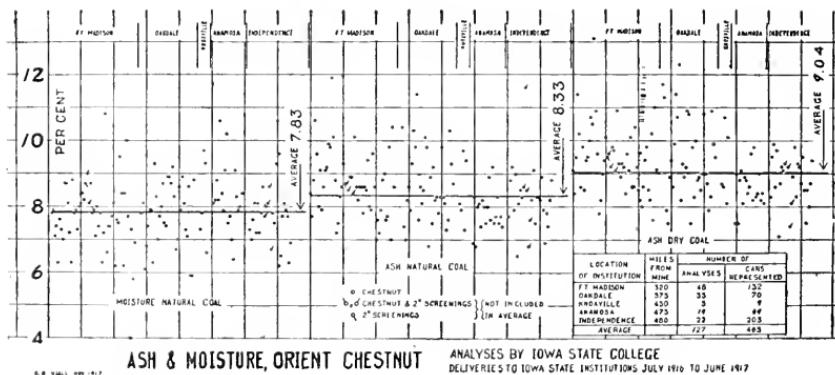
CHAPTER XXIII

COAL ANALYSIS A GUIDE ONLY

Not the Last Word.—In reaching a conclusion concerning the best coal to purchase for your particular plant, the chemist's analysis of the various coal samples should be regarded as a guide only, and not as a factor of prime importance. Coal buyers of long experience regard their analytical reports much as they regard commercial reports, i. e., an excellent guide and check upon their own conclusions, but by no means as the last word on the subject.

These statements should not be regarded as a reflection upon the accuracy of the chemical reports, although laboratory practice is not as thoroughly standardized as one might wish. The principal difficulty lies, not in the laboratory work, but in the difficulties encountered in securing fair and representative samples. Most of the sampling is done by young

CHART I



men with rather limited experience and some sampling is deliberately unfair.

Coal Samples.—Even when the samples are taken by men of experience who exercise the utmost care, wide variations occur. The usual practice is to divide the sample into three equal parts, sealing each in an air-tight container. One part

is analyzed and the other two parts are kept, in order to make a check on the first analysis in case of dispute. Frequently the reported analysis of two parts of the same sample will show a variation in moisture and ash of 1 to 4 percent., and in B. T. U. a variation of as much as 10 percent.

Charts Show Variations.—This is best illustrated by the following charts, supplied through the courtesy of the Chicago, Wilmington & Franklin Coal Co.:

Chart 1 represents graphically the results of 127 analyses of samples from 483 carloads of coal. This coal was all shipped from the same mine, carefully sized through 1 $\frac{1}{4}$ -inch round perforation, and over $\frac{3}{4}$ -inch round perforation. Each circle represents the result of one analysis. You will note the moisture variation is 4 percent. to 10.8 percent., while the average is 7.83 percent.

CHART II

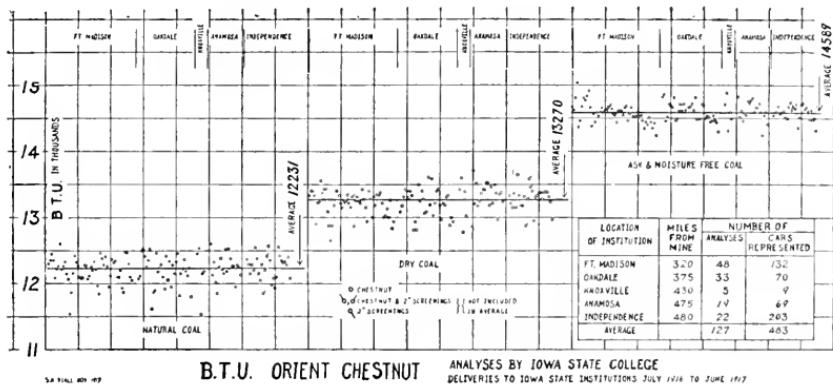


Chart 2 represents B. T. U. analyses for the same samples. These charts indicate clearly that it requires approximately 20 analyses before one is reasonably certain they have average conditions. Undoubtedly, many of the variations in analysis are made in the sampling.

Chart 3 represents B. T. U. values for coal shipped from the same mine to State institutions in Illinois and Iowa during the same year. The B. T. U. values have been calculated to a "moisture and ash free" basis for better comparison of laboratory results. Note that the averages of the two laboratories do not check by about 2 percent.

CHART III

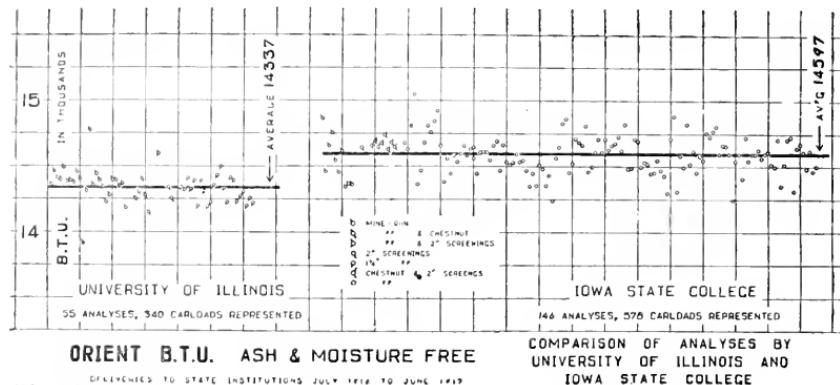


CHART IV

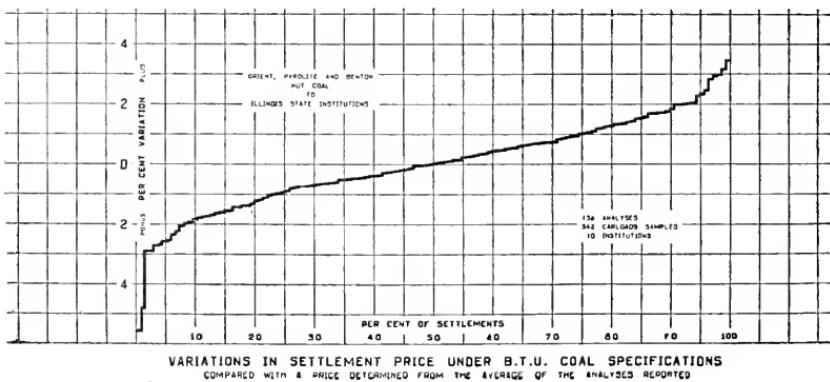


Chart 4 represents the variation in settlement price under so-called B. T. U. contracts. For this chart 136 analyses were averaged. The price was calculated for the average analysis on a basis of 40,000 B. T. U. for one cent, then the price for each individual analysis was calculated on a basis of 40,000 B. T. U. for one cent. The difference between the price for each analysis and the average price was divided by the price for the average. The result was expressed in percentage, then the various results were arranged in a set order, the report showing the lowest price being placed first, the highest price being placed last, and the other arranged in proper position between.

This chart is typical of others prepared in a similar way. Variations are undoubtedly brought about by the fact that the one preparing the sample could include an excessive

amount of ash or moisture far more readily than he could exclude these items, with the result that the quality, as determined by the laboratory, was quite poor.

CHART V

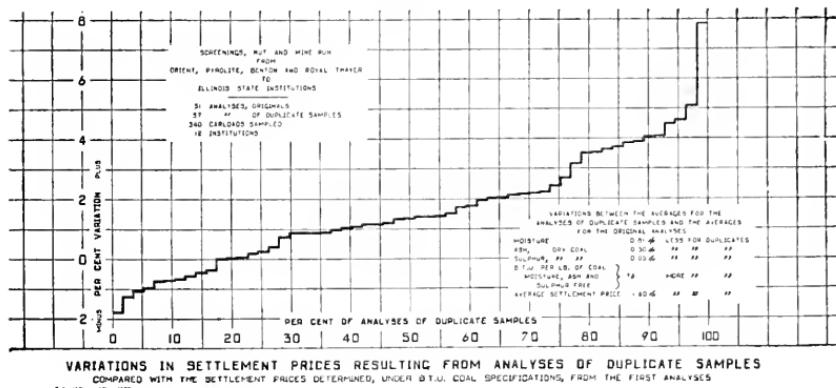


Chart 5 was prepared to illustrate the influence of sampling. In this case there were 51 analyses made from original samples and settlement prices were calculated for each of these analyses. Later, so-called duplicate samples, prepared at the same time the originals were made, were analyzed, and prices based on the results of the second analyses calculated.

The difference in cents between the price calculated from the results of the original analyses as compared with the price for the duplicate analyses, was divided by the price determined from the original analyses, and the results expressed in percentages.

The various results for all the duplicate samples were then arranged in a set order. The report that showed the greatest reduction in price, as compared with the original, was placed first, and then in proper order, all the other reports, until the one showing the greatest increase in price was placed last.

In May, 1921, we purchased four cars of coal from one of the largest operators in the southern Illinois district. A commercial chemist of unquestioned integrity was instructed to have his own assistant prepare and analyze a fair sample from the four cars. There is every reason to believe that this sample was taken carefully, and that the laboratory work was accurate. The operator had another commercial chemist make a separate analysis of each car.

The first analysis in the table is of a composite sample from the four cars taken by the chemist for the buyer; the next four analyses are the reports by the seller's chemists on each car:

	1	2	3	
	<i>As Received</i>	<i>Dry Basis</i>	<i>As Received</i>	<i>Dry Basis</i>
Moisture,	11.04	8.63	8.40	
Vol.	30.49	34.27	37.53	41.07
Fixed Carbon,	41.17	46.28	38.99	42.68
Ash,	17.30	19.45	14.85	16.25
Sulphur,	4.07	4.58	3.77	4.13
B. T. U.	10066	11315	10921	11953
	4		5	
	<i>As Received</i>	<i>Dry Basis</i>	<i>As Received</i>	<i>Dry Basis</i>
Moisture,		8.67		9.23
Vol.		36.96	40.46	33.99
Fixed Carbon,		39.69	43.46	40.66
Ash,		14.68	16.08	16.12
Sulphur,		3.79	4.15	2.93
B. T. U.		11008	12053	10663
				11747

As a farther illustration, the following chart gives the result of 16 chemical analyses of coal of the same size, delivered from the same mine, over the period May 6 to June 10, 1921. The first column is the "as received" basis, the second column the "dry" basis.

POCAHONTAS COAL COMPANY

	<i>As Received</i>	<i>Dried</i>	<i>As Received</i>	<i>Dried</i>	<i>As Received</i>	<i>Dried</i>	<i>As Received</i>	<i>Dried</i>
	<i>May 6, 1921</i>	<i>May 11, 1921</i>		<i>May 16, 1921</i>		<i>May 31, 1921</i>		<i>May 26, 1921</i>
Moisture.....	9.70	none	9.22	none	9.49	none	9.63	none
Vol. Comb. Matter.....	29.49	32.66	29.44	32.43	28.54	31.53	28.63	31.68
Fixed Carbon.....	48.12	53.29	52.84	58.21	51.65	57.07	48.88	54.09
Ash.....	12.69	14.05	8.50	9.36	10.32	11.40	12.86	14.23
Sulphur.....	1.12	1.24	.72	.79	.86	.95	1.79	1.98
B. T. U.....	11321	12537	11909	13119	11566	12779	11265	12465
	<i>May 28, 1921</i>		<i>May 28, 1921</i>		<i>May 31, 1921</i>		<i>June 1, 1921</i>	
Moisture.....	9.89	none	10.67	none	9.38	none	10.60	none
Vol. Comb. Matter.....	28.84	32.00	27.51	30.80	28.01	30.91	29.58	33.09
Fixed Carbon.....	51.02	56.62	50.34	56.35	52.05	57.44	50.65	56.65
Ash.....	10.25	11.38	11.48	12.85	10.56	11.65	9.91	10.26
Sulphur.....	.83	.92	.85	.95	.84	.92	.91	1.02
B. T. U.....	11591	12863	11307	12658	11521	12714	11544	12913
	<i>June 2, 1921</i>		<i>June 3, 1921</i>		<i>June 4, 1921</i>		<i>June 6, 1921</i>	
Moisture.....	9.59	none	10.57	none	8.41	none	8.45	none
Vol. Comb. Matter.....	28.52	31.54	27.93	31.23	28.91	31.54	29.47	32.19
Fixed Carbon.....	51.92	57.43	50.71	56.71	51.94	56.73	50.94	55.64
Ash.....	9.97	11.03	10.79	12.06	10.74	11.73	11.14	12.17
Sulphur.....	.85	.94	.84	.94	1.32	1.44	1.09	1.19
B. T. U.....	11653	12889	11412	12761	11817	12902	11691	12770
	<i>June 7, 1921</i>		<i>June 8, 1921</i>		<i>June 9, 1921</i>		<i>June 10, 1921</i>	
Moisture.....	8.60	none	8.09	none	9.58	none	11.78	none
Vol. Comb. Matter.....	28.24	30.90	29.94	32.57	30.99	34.27	29.24	33.15
Fixed Carbon.....	51.56	56.41	50.77	55.24	49.32	54.55	49.93	56.59
Ash.....	11.60	12.69	11.20	12.19	10.11	11.18	9.05	10.26
Sulphur.....	.84	.92	.86	.94	.93	1.03	1.03	1.17
B. T. U.....	11579	12669	11713	12744	11716	12957	11361	12878

Note that each analysis totals 100% without the sulphur. This is because the sulphur is contained in the other constituents.

CHAPTER XXIV

TECHNIQUE OF COAL STORING

Little Data Available.—Considering the importance of the subject, and the amount of money lost every year through spontaneous combustion of coal in storage piles, there is very little authoritative information available concerning the technique of coal storage. There are nearly as many methods of coal storage as there are types of power plants.

The following paragraphs are based upon the rather scanty Government data, upon the researches of H. H. Stoek, of the University of Illinois, and upon the personal experiences and observations of the author.

Lignite.—Because of the large amount of moisture contained in lignite, it cannot be safely stored except under water. Many lignites disintegrate so rapidly when exposed to the air that they cannot be profitably transported very far in open top cars, except under unusual conditions. The moisture content of lignite is about 40 percent. Lignite is, therefore, a negligible factor in the total coal supply, except for local consumption in districts where it is mined.

Bituminous.—Before the World War the price of bituminous coal was so low, the supply apparently so great, and the transportation system seemingly so adequate, that the storage of bituminous coal received scant consideration, and few found it necessary to accumulate large storage piles. Because of the limited need for storage there were few losses from spontaneous combustion, and the coal was so cheap that these losses were not considered of much moment.

War Compelled Storage.—In preparing for the winter of 1917 and 1918, however, it was considered not only a wise precaution, but the duty of every good citizen, to accumulate during the summer and early autumn a large part of his coal requirements for the coming winter. Because huge storage piles were built up in a more or less haphazard manner, heavy losses were caused in many instances by spontaneous combustion. No one knew just what to do, and there was no one whose experience was broad enough to guide us in the technique of coal storage. The record of these storage losses,

and the variety of deductions drawn therefrom, remind one of the statement of a Chicago jurist that, "given time, he could cite authoritative court decisions on either side of any case."

Experience Failed to Teach.—As a result of the experience of 1917 and 1918 and the years following, many men believe they saved their storage piles from burning by the installation of elaborate ventilating systems in the coal piles. Others are equally certain that the ventilation of storage piles is the surest way to induce spontaneous combustion.

H. H. Stoek, professor of mining engineering at the University of Illinois, however, gave this problem much study, and has reduced the problem to somewhat more simple terms by a careful classification of the coal piles which burned, and those which did not burn.

Prof. Stoek's Conclusions Summarized.—His conclusions are presented in a pamphlet published March 4, 1918, as Bulletin No. 27, of the University of Illinois. They may be summarized as follows:

1. The determining factor is not so much the kind of coal as its size and preparation.

2. As spontaneous combustion is due to the heat generated by the oxidization of the coal, there are two methods of preventing or retarding the generation of this heat.

A. Exclude all air from the pile.

B. See that the pile is so well ventilated that the free circulation of air will carry off the heat as fast as it is generated.

It appears, therefore, that prepared sizes of coal from almost any district can be safely stored if the sizes are not mixed in the pile, because the air can freely circulate through the mass of the coal pile, and so carry off any surplus heat as fast as it is generated.

Power Plant Experience.—W. L. Abbott, chief engineer of the Commonwealth Edison Co. of Chicago, is quoted on this subject as follows:

"The experience of the Commonwealth Edison Co. after storing large amounts of all varieties of coal, and particularly Illinois coals, for a number of years, may be summarized as follows:

"Nearly any coal which has gone over a $1\frac{1}{2}$ -inch screen can be stored. Any size of coal with duff left in will heat.

"Pea coal over one-half inch through three-fourths inches

has been in storage for more than a year without heating. Coal with screenings removed has been in storage eight years without firing.

"Heating usually occurs within three months after the coal has been stocked, and the tendency to heat decreases rapidly after that period.

"Coal in storage piles shows no measurable loss of heating power, although weathering reduces the lumps on the outside of the piles to slack.

"As insurance, cost of handling, etc., are the same for all grades of coal, regardless of heat value, it is more economical to store the better grades."

As the partial ventilation of a coal pile seems to aid spontaneous combustion, the addition of even the most elaborate ventilation systems would seem to add to the danger, because it is manifestly impossible to really ventilate the whole pile unless the pile itself is so constituted that the air freely circulates, as in a pile of egg coal.

Storage of Screenings.—The University of Chicago has stored screenings for many years in amounts varying from 1,000 to 10,000 tons with the following results:

1. Inch and a quarter Pike County, Indiana, screenings were frequently stored nine feet high during the winter months with only occasionally a slight loss from fire.
2. The same screenings when mixed with coal from other parts of Indiana caused constant difficulty.
3. Illinois and Indiana screenings when mixed usually fired. A factor to be considered is the tendency of the pile of prepared coal to disintegrate under the process of weathering. If a pile of egg coal is from a district whose coal tends to disintegrate readily after being exposed to the air, it is quite evident that after a few days you will have, not a pile of egg coal, but a pile of egg coal mixed with slack formed by the weathering process. This slack tends to fill the interstices between the coal, retards the circulation of air through the pile, and so adds to the danger of spontaneous combustion. Because of this it is well to attempt to store coal from only the best districts.

4. When coals from different parts of Illinois were mixed they usually fired.

5. Inch and a quarter or two-inch screenings taken from the same mine in southern Illinois, piled on dry ground dur-

ing dry weather, not more than nine feet high with no ventilating devices of any kind, have never fired yet.

There seems to be no reasonable doubt that the presence of straw, bits of wood or pieces of oily waste increase the tendency to spontaneous combustion. The presence of a steam pipe or a sewer carrying warm sewage under or near the coal pile often raises the temperature just enough to cause fire.

Handling Coal Pile Fires.¹—"Opinions differ widely concerning the critical or dangerous temperature in a coal pile. Parr says, 'Bituminous coal can be stocked without appreciable loss of heat value provided the temperature is not allowed to rise above 180 degrees F.' How near to this temperature a pile should be allowed to heat is largely a matter of judgment. If the rate of rise in temperature is decreasing rapidly, it may be safe to allow the temperature to approach 180 degrees, but if the rise is steady and regular, it is wise to load out the pile before this danger point is reached. The extent of rise allowable also depends upon the means available for loading out. At a plant equipped with a large grab bucket, or other means for rapidly handling the coal, a higher temperature can be permitted than in cases in which a considerable period is necessary to load out the coal. A person in charge of a certain kind of coal under certain climatic conditions will, with a little experience, be able to determine the danger point. It is impossible to set any critical temperature which will apply to all coals under varying storage conditions. One very safe rule is to be ready to move the coal if the temperature reaches 150 degrees F. and to load it out if the temperature rises to 175 degrees.

"Water has often not proved effective in putting out fires, doubtlessly because of the fact that it was not applied in sufficient quantities to cool the entire mass thoroughly. An insufficient amount of water will aggravate rather than stop an incipient fire. One large pile in Chicago was soaked as completely as possible with streams from river fire tugs, and while the fire was at the time apparently extinguished, it began burning again within two or three days. If the coal can be spread out and thoroughly saturated with water, the fire can be extinguished, but often there is not sufficient ground available to permit proper spreading.

¹The quoted paragraphs are from Bulletin No. 27, University of Illinois, pp. 35 and 36.

"In a private communication, Dr. J. B. Porter says: 'I fully appreciate the fact that nearly everybody experienced in the storage of coal objects to the use of water for quenching fires in storage piles. I express scepticism as to the harmfulness of water-quenching. Recent information strengthens this scepticism, and I have come across several cases of successful fire-fighting by the intelligent use of water. The fuel agent of the Canadian Pacific Railway states that he always recommends the use of water, if the fire is a small one, and particularly if it is detected in an incipient stage. His practice is to locate the hot spot by driving test rods into the pile, and then to dig a pit one or two feet deep right over the center of trouble; to drive and pull pointed rods or open pipes from it down into the heating mass, and then to fill the pit with water, thus quenching the fire at its very center. At the same time, if the fire is a large one, he surrounds the whole heated part with a water curtain, made by digging a ring ditch one or two feet deep, and perforating its bottom with a row of holes as in ventilation. This ditch, like the central hole, is kept full of water from the hose, and if there is any tendency for the fire to be driven outward from the center, it is quenched by the water curtain.'

"This method of putting out a fire is, of course, costly, but it is enormously quicker and less costly than that of digging out, and results in far less loss of material. Personally, I am confident that it will prove successful in any ordinary case.'

"Inert gases, such as carbon dioxide, have been tried as fire extinguishing agents."

Deterioration of Coal from Storage.—In the early days of coal storage, when coal was cheap, most engineers used to estimate a loss of 10 to 15 percent. in heat value because of weathering. Because of this it is rather surprising to note the following statement from the University of Illinois Bulletin No. 27:

"The loss of heating value resulting from storage is comparatively small, and Parr says with regard to this: "Bituminous coal can be stocked without appreciable loss of heat values provided the temperature is not allowed to rise above 180 degrees F. In fact, there is no appreciable evolution of CO₂ at temperatures below 260 degrees F. The indicated heat loss per pound of coal is due more largely to an increase in

weight of a unit mass of coal resulting from the absorption of oxygen, rather than from an actual deterioration or loss of heat units. . . . Under-water storage prevents loss of heat value."

According to detailed values given by Parr and summarized in the following table, the indicated loss of heating value is relatively low.

Decrease in Heating Value, B.T.U., of Illinois Coals.

Coal Tested and Length of Time Stored	NUT		SCREENINGS		NUT	SCREEN- INGS
	Exposed Bins	Covered Bins	Exposed Bins	Covered Bins	Under Water	Under Water
	Percent	Percent	Percent	Percent	Percent	Percent
Stored 1 Year						
Williamson County.....	0.84	1.64	1.37	1.35	0.93	0.57
Vermillion County.....	2.13	2.77	3.92	4.46	2.00	2.72
Sangamon County.....	3.15	4.12	5.14	4.52	1.83	0.86
Stored 3 Years						
Williamson County.....	2.09	3.60	2.11	3.73	.....	.....
Vermillion County.....	4.98	6.23	8.48	10.47	.....	.....
Sangamon County.....	4.54	.....	7.11	10.48	.....	.....
Stored 6 Years						
Williamson County.....	3.04	3.60	3.96	4.31	.....	.....
Vermillion County.....	5.49	6.39	10.83	.....	.....	.....
Sangamon County.....	6.49	6.81	6.85	10.81	.....	.....

After a period of one year in storage, the loss averaged for nut coals and screenings from Williamson, Sangamon and Vermillion counties, only about 3 or $3\frac{1}{2}$ percent. Coals vary in this respect, those from Southern Illinois showing less change than those from Central Illinois, and this difference increases with the length of time in storage; that is, the coals which show a small decrease in heating value at first continue to show a relatively small decrease as time goes on.

More Facts Regarding Deterioration.—Decrease in heating value is consistently greater with screenings than with screened nut, according to Parr's tests of Illinois coals.

Coal stored in open bins shows consistently a lower percentage of loss of heating value than coal stored under cover, due no doubt to the oxidation of the sulphur when exposed to the air, and its subsequent leaching out.

Experiments made by the Bureau of Mines upon larger samples of coal gave the following results:

"The amount of deterioration of coal in heating value during storage has commonly been overestimated. Except for the sub-bituminous Wyoming coal, no loss was observed in outdoor weathering greater than 1.2 percent. in the first year, or 2.1 percent. in two years. The Wyoming coal suffered somewhat greater loss, 2 to 3 percent. in the first year and as much as 5.5 percent. in three years."

Factor in Storage.—Therefore, as the coals which do not show excessive degradation during storage also show heat losses of only 1 percent. to 3 percent., the storing of coal resolves itself into the following factors:

- A. Necessity of storage in order to assure an adequate supply. This, of course, depends upon the location of the plant and the condition of the transportation.
- B. Variations of cost between seasons of the same year—whether the price shows marked variations consistently.
- C. Cost of rehandling.
- D. Adequacy and cost of storage facilities.
- E. Available funds for investment in coal and the interest charged.
- F. Could these funds be used to better advantage elsewhere?

Conclusion.—Generally speaking, enough coal should be placed in storage to serve as an insurance against failure to receive regular shipments—usually 30 to 60 days' supply. Only under unusual circumstances will it pay to accumulate a larger stock pile. Usually the rehandling cost, degradation, interest and other charges will offset any theoretical saving achieved by the accumulation of large stocks of coal.

CHAPTER XXV

PROBLEMS IN STEEL BUYING

Scope of Chapter.—As every purchasing agent buys more or less material made of iron and steel, he should know enough about their history and development, and the modern processes of manufacture, to enable him to buy this class of product to the best possible advantage. It is by no means unusual for a purchasing agent of many years' experience to make costly blunders in handling purchases of this sort because he lacks a knowledge of the basic principles of the manufacture of these products.

It is, of course, impossible adequately to cover here the technique of the whole field of the manufacture of iron and steel. We shall cover only the basic principles, and point out only the more obvious difficulties and the most common stumbling-blocks.

Chemistry.—Much of the manipulation of iron depends upon the simple chemical law that the action of any acid tends to be neutralized by a base or an alkali, and that the resultant of the reaction of an acid with a base is a neutral salt. Both acids and bases vary in strength and in the intensity and rapidity of reaction. The reaction of a small quantity of acid with a large quantity of base results in a slightly lessened amount of base and a slight amount of a salt. These reactions are, of course, determined by the exact properties and exact strength of both the acids and bases, and are interpreted in the terms of chemical formulæ, with which we are not now concerned.

Common Elements.—The common elements met with in the manufacture of steel are:

1. Iron.
2. Carbon exists in iron in two forms, combined and uncombined in the form of flake graphite.
3. Phosphorus is found in varying quantities in all iron ores.
4. Silicon is found in most iron ores, in various forms.
5. Oxygen, which exists in the air in the free or uncom-

bined form, and in limestone, clay, quartz, iron ore, and other substances in the combined form.

6. Hydrogen, which is contained in the moisture of the air, and in the gases used.

7. Other elements which play a more or less important part in the manufacture of steel are aluminum, chromium, manganese, calcium, and magnesium.

Refractories.—The purchasing agent for a steel mill must know a great deal about the various kinds of refractories and the uses to which they may safely be put, and those to which they are not adapted. It is true that the matter of specifying the type of refractories required usually lies outside the province of the purchasing agent, but the buyer who is really seeking to serve his firm to the best possible advantage must know the purpose for which every item is purchased, in order intelligently to coöperate with the operating head of the mill, and in order to suggest workable substitutes. Briefly the specifications for a perfect refractory are:

1. Must not soften or fuse.
2. Must not crumble or crack.
3. Must exhibit the minimum amount of contraction and expansion.
4. Must be non-conductor of heat.
5. Must be impermeable to gases and liquids.
6. Must resist abrasion.
7. Must not react chemically with other substances.

The man who can discover a refractory that will measure up to these seven requirements will make a very great contribution to the progress of the human race, and will earn a good deal of money for himself.

The Three Classes.—Refractories are divided into three classes, basic, acid, and neutral. To the first class belong bauxite, dolomite, magnesium, and lime. All acid refractories owe their acid quality to the presence of silica in varying forms and in varying quantities. The ideal furnace lining would, of course, be a neutral material which would permit the furnace to be operated on either the basic or acid process. Only two such substances—graphite and chromite—are now known, and it is not commercially possible to use either for large operations.

The selection of a refractory for any purpose should be made only after exhaustive tests conducted in the laboratory, where actual working conditions to which the refractory will later be put are duplicated as far as possible. These laboratory tests determine the fusing point, resistance to compression, expansion and contraction, density, resistance to abrasion, resistance to impact, and liability to spall.

Fuel.—In the production of steel, large quantities of fuel must, of course, be used. As nearly every purchasing agent buys more or less fuel, perhaps a brief discussion of the fuel problems of the steel mill will not be out of place here. The following excellent chart of fuels is taken from page 66 of "The Making, Shaping, and Treating of Steel," published by the Bureau of Instruction of the Carnegie Steel Co. For the purpose of this chapter it is only necessary to add that the principal fuels used in the manufacture of steel are coke and gases, both natural and manufactured.

Classification of Fuels

Carbon-Hydrogen Fuels	Solid	Natural	Wood	Hard Soft
			Peat	New Old
			Lignite	New Old
			Coal	Bituminous Anthracite
		Prepared	Coking	Non-Coking
			Briquettes	
			Pulverized Coal	
			Carbonized Fuel	Charcoal Coke
				Beehive Bv-Product
		Liquid	Petroleum	
			Distilled Oils	
Incidental Fuels	Gaseous	Natural	Coal Tar	
			Natural Gas	
		Prepared	Producer Gas	
			Blast Furnace Gas	
			Coke Oven Gas	
			Coal Gas	
		Bessemer Converter	Blue Gas	
			Iron	
			Manganese	
			Carbon	
		Sulphur Works	Silicon	
			Phosphorus	
			Roasting	
			Smelting	

Fluxes.—The purification of iron ore depends very largely upon the addition of the right kind of fluxes in the right quantities. They accomplish two things: first—they render some of the impurities more easily fusible, and second—they combine with other impurities, and so are drawn off in the form of slag.

Some of the impurities contained in iron possess a marked affinity for the iron, and can only be separated by the addition of a flux for which they have an even greater affinity. The selection of the right flux will, therefore, depend upon the chemical composition of the iron, and the properties of the impurities which it contains.

Basic and Acid Types.—If the iron contains basic impurities, an acid flux must be used; and if the impurities are acid, a basic flux will be required. Some fluxes do, however, possess peculiarities. For instance, alumina may, under certain conditions, become either an acid or a base. Alumina with silica forms aluminum silicate which is an acid; with sodium it forms sodium aluminate which is a base. In conjunction with other bases alumina exhibits a tendency to form double salts with polybasic acids.

While alumina is seldom intentionally used as a flux, it is present in varying quantities in nearly all the raw materials used in the manufacture of steel. The most common basic flux is limestone and dolomite; silica is the only acid flux.

Slag.—Blast furnace slag is used for the manufacture of Portland cement, for road building, railroad ballast, roof covering, insulating materials, fertilizer, and for brick.

Pig Iron.—While the number of purchasing agents who have occasion to buy pig iron in large quantities is not large, I believe that a knowledge of the elementary principles of the making, selling, and the technique of purchasing pig iron will be worth while for every purchasing agent. Certainly the student who hopes some day to direct the expenditure of millions of dollars of other people's money cannot have too much accurate information upon any subject.

Pig Iron Sales.—While pig iron is produced in large quantities in this country, comparatively little of this iron ever finds its way into the market in that form. Pig iron is in reality the intermediate state in the manufacture of steel, and the largest producers of pig iron seldom have any to sell, because they convert all their normal output into steel, and

vend it in that form. Owing to this condition the manufacture of commercial pig iron is largely in the hands of relatively small concerns. In fact, many of these producers are so small, and their output is so limited, that they simply cannot afford to support a sales organization. Because of this, and because of the economic advantages this method offers, the large volume of commercial pig iron is sold through brokers.

Brokers and Trade Customs.—Some of these brokers handle the output of many furnaces. Some of the furnaces use the services of one broker for a while, and then switch to another. Some furnaces are represented by a broker in several localities, in order to take advantage of the most advantageous conditions in each district.

The custom of paying the brokers on the basis of a flat commission per ton instead of on a percentage basis led to the growth of a peculiar trade abuse. As the amount of money the broker received did not depend upon the price he received for the pig iron, he had no real interest in keeping the selling price up. This, in turn, led to the "bid or offer" method of purchase and sale.

When a broker learned that a plant was in the market for a thousand tons of pig iron of a certain specification, he quoted the price the furnace had instructed him to quote. If that price did not secure the business, he then asked the purchasing agent to make him a bona-fide offer which he could submit to the furnace.

Inexperienced Buyers.—One of the common methods used by the pig iron broker to try out the new purchasing agent was to ask for an offer on a given lot of pig. If the market price was \$19 per ton, and the purchasing agent offered \$18.50 or \$18.75, the broker at once concluded that the new buyer at least knew something about pig iron, and acted accordingly.

If, however, the new buyer were to look wise and offer only \$16 a ton, the broker at once knew that he was green and acted accordingly. It is perhaps needless to say that the majority of well established brokers would at once proceed to give the buyer valuable information concerning the pig iron market, and would thereby lay the foundation for a friendship which might prove very profitable to both of them.

There are, of course, always some brokers of the other

type who would take advantage of the buyer's inexperience to attempt to get an unduly high price for their iron. On the other hand some purchasing agents have been so disagreeable to salesmen, and so sure that they knew all there was to know about a given commodity, that they have more than justified all the rough treatment meted out to them by the salesmen and brokers during the past few years.

Analysis of Pig Iron.—Let us now consider briefly the nature, characteristics, possibilities and limitations of pig iron. As pig iron is never used for anything except ballast until it has been refined and converted into some other form, and as the service which the finished product may render is limited not only by the various processes through which the iron is put, but to a greater or lesser extent by the chemical composition of the iron, it is highly desirable that the purchasing agent know the significance of these various substances which are found in pig iron.

In the solid form, iron represents a complex mixture of alloys, compounds, and uncombined elements. Pure iron usually constitutes 91 to 94 percent. of the whole. Of the remainder, 3 to 4 percent. is carbon, .50 percent., to 3 percent. is silicon, less than .065 is sulphur, .040 to 2 percent. is phosphorus, and .02 to 1.50 percent. is manganese.

Impurities in Iron.—When pig iron contains more than 4 percent. of carbon, it becomes very brittle. Carbon appears in pig iron in the combined form, and in the uncombined form, the free form consisting of small flakes of free graphite. Experts are not quite agreed concerning the exact effect of sulphur in pig iron, but foundry men are quite agreed that it is not desirable to use pig iron containing more than .05 percent. sulphur.

A small percentage of phosphorus is desirable in making cast iron, because it makes the iron flow much more freely, eliminates blowholes, and decreases shrinkage; but the tensile strength of iron containing more than one-half of 1 percent. phosphorus is greatly reduced.

The student who wishes an accurate chart of the upper and lower limits of the various impurities in pig iron will find a very useful chart on page 120 of "The Making, Shaping, and Treating of Steel," published by the Bureau of Instructions of The Carnegie Steel Company and referred to above.

The Metallic Products of the Blast Furnace

Grade	Range in Percent. of				
	Silicon	Sulphur	Phosphorus	Manganese	Total Carbon
No. 1 Foundry.	2.5 to 3.0	Under .036	.25 to 1.00	Under 1.00	3.00 to 4.25
No. 2 Foundry.	2.0 to 2.5	.045	.25 to 1.00	1.00	3.50 to 4.25
No. 3 Foundry.	1.5 to 2.0	.060	.25 to 1.00	1.00	3.50 to 4.25
Malleable Casting.....	.75 to 1.5	.050	.2	1.00	3.50 to 4.25
Forge.....	About 1.50	1.00	1.0	1.00	3.50 to 4.25
Acid Bessemer.	1.00 to 1.50	.050	0.1 or less	About .50	3.50 to 4.25
Basic Bessemer	Under 1.00	.050	.....	Under .50	3.50 to 4.25
Low Phos. Acid Iron.....	2.00	.030	.030	1.00	3.50 to 4.25
Basic.....	Under 1.25	.050	.100 to 1.00	1.00 to 2.50	3.50 to 4.25
Spiegel.....	About 1.00	.050	.150	18.0 to 22.0	5.0 to 6.0
Ferro-Manganese.....	.50 to 1.00	.030	.10 to .30	78.00 to 82.00	5.0 to 7.0
Ferro-Silicon....	8.0 to 15.00	.070	.10 to .50	.....	1.00 to 2.00
Silico-Spiegel ..	8.0 to 15.00	.010	.15	15.00 to 20.00	.....

Blast Furnace.—While the actual work of producing pig iron calls for the setting up of blast furnaces, and while the profitable operation of these furnaces calls for considerable skill, and a thoroughgoing knowledge of both the physical properties of iron ores and the chemical reactions which may be expected in the operation of the furnaces, the non-technical description of the process of making pig iron is very simple.

The blast furnace, which is in reality nothing more than a huge brick stack, is first heated up and then filled with coke, limestone, and iron ores, of known analyses and quantities. The heat generated by the burning coke aided by the heat generated by the gases, melts the iron. The molten iron, containing a greater or lesser amount of impurities, collects in the bottom of the furnace, and is periodically drawn off and cast into pigs.

The limestone and other fluxes unite with the impurities in the iron, and rise to the top as slag. All during the process, while the iron is running out, small samples are taken, and tested both chemically and physically. Because of the high temperature required for the operation of a blast furnace, and because of the difficulties encountered in closing down and opening up again, a blast furnace usually makes one continuous run from the time it is first put into commission until it is burned out and re-lined.

Bessemer Furnace.—One of the commonest and, on the whole, one of the most satisfactory methods of purifying pig iron for making castings and ingots, and for other commercial purposes, is known as the Bessemer process. Briefly, and shorn of all the technicalities, the process depends upon the principle that the introduction of a blast of air through the bottom of a vessel containing molten iron generates heat because it supplies the oxygen necessary to burn out the carbon and other impurities in the iron. In general the practice is to continue the blast of air until all the impurities are burned out, and the vessel contains very nearly pure iron.

Various alloys are then added in the quantities required. The furnace master determines by the length and colour of the flame just when the heat has reached the right stage. Here, again, the results desired and the results obtained, are checked by frequent analyses and physical tests.

Steel.—Open Hearth.—As opposed to the Bessemer process, we have the open hearth process of purifying iron. In this process the heat is obtained by the introduction of blasts of burning gases forced over the iron, instead of a blast of air forced up from the bottom. This method has an advantage in that the temperature of the bath can be more accurately controlled, and the process may, therefore, be lengthened out so that only those impurities which are not desired will be eliminated. This makes it possible to obtain iron with a greater range in analysis.

Analyses of Hot Metal and Slag Before Charging and at Time of First Run Off

Heat No.	ANALYSIS OF METAL Percent. of						PARTIAL ANALYSIS OF SLAG Percent. of						
	C	Mn	P	S	Si	SiO ₂	FeO	Fe ₂ O ₃	MnO	CaO	MgO	P2O ₅	SO ₃	S
1. Pig Iron before charging.....	3.85	1.55	.198	.035	1.04	4.72	66.67	not	1.30	18.00	2.00	.78	.....
1. At time of run off.	2.39	.05	.022	.040	.04	19.19	32.86	5.22	12.97	18.38	6.11	1.11	.....
2. At time of run off.	2.41	.02	.053	.060	.....	25.18	17.39	4.07	13.16	17.88	12.18	.....	.029
3. At time of run off.	3.45	.02	.068	.049	.....	23.68	26.33	7.10	13.54	12.22	10.14	.....	.027
4. At time of run off.	2.80	.01	.015	.043	.....	15.74	45.16	7.50	6.19	11.34	5.23	.....	.037
5. Briquettes Instead of Ore Used.....	3.74	.01	.043	.037	.....	19.30	42.59	5.91	6.84	12.41	3.84	.....	.182
													.063

Taken from "The Making, Shaping and Treating of Steel."

Electric Steel.—The outstanding factor in the manufacture of steel by the electric furnace is the utilization of the heat generated by the electric arc. The particular advantage of the electric furnace lies in the fact that the heat may be directly applied and accurately controlled, and that this method of heating makes it possible to exclude all foreign substances.

It is thus possible to produce a steel of great fineness and purity. Steel made by this process may almost exactly duplicate steel made under ideal laboratory conditions.

Ingots and Their Defects.—Steel for commercial purposes is shaped in many forms, and by many means, by rolling, pressing, and hammering; and each method has its advantages and its disadvantages. There are certain inherent defects in most steel ingots and billets that the purchaser of steel and steel products in their various forms should know about, and be able to recognize. The process of cooling an ingot is very much like the process of freezing a cake of ice.

When the molten steel is poured into the mould it begins to harden or freeze from the outside first, because the mould acts as a conductor of heat. The metal contracts as it cools, so there is a constant tendency to form a long opening in the upright end of the ingot, called a pipe. In fact, no method has yet been devised for the successful elimination of this pipe, which does not cost more than it saves. Because of this inherent defect in the ends of the ingots, the end is always discarded before the steel is put through the rolling mills.

The second common defect in the finished ingot is the blow-hole. In the molten state, iron is capable of absorbing large quantities of gases, and these are given off as the iron solidifies. Some of these gases become entrapped as the iron cools and remain in the form of bubbles which show up in the finished product as blowholes. The size of these blowholes may be very large or very small. If they are located near the center of the ingot, they become closed by the rolling process, and have no ill effect on the finished piece. If, however, they are near the skin of the ingot, and the surface of the blowholes becomes oxidized, the rolling process does not completely weld them, and they show up later in the form of splinters, checks, or scabs. The inadvertent inclusion of small bits of slag in the finished ingot shows up in a similar manner.

Scale.—During the rolling process more or less scale forms

on the outside of the ingot or slab. In order to prevent the finished product from showing pits on the surface, this scale must be removed. When working low carbon steel the scale is removed by spraying with water, and at the same time throwing quantities of salt on the hot iron. When working high carbon steel, burlap sacks are thrown on, in addition to the salt and water. When working nickel steel, coal is used in the place of salt, and in addition to burlap sacks. In some cases, brush and green twigs are used in the place of the burlap sacks. This material thrown upon the hot ingot or slab, is drawn under the rolls and gassified by the heat from the steel. In escaping, the gases get under the scale, and carry it off.

Tears.—In regulating the draught of the rolls in the rolling mill, great care must be exercised. If the draught is too great, or the ingot too cold, the action of the rolls causes the bloom or ingot to tear or split on the edges. These tears may be more or less perfectly welded in the later working of the piece.

Structural Changes in Steel in Work.—Before leaving this brief summary of first principles in the manufacture and working of steel, I believe some little space should be devoted to the study of the structural changes which take place in steel when it is heated and when it is cooled, under varying conditions. A thorough knowledge of this subject would prove invaluable to any purchasing agent who is concerned in the purchase of machinery and repair parts. Every year many thousands of dollars' worth of cracked and broken parts are discarded upon the advice of engineers, which could be repaired at a slight cost, if they were properly handled by an expert repair force.

Carbon.—The presence of carbon in steel in known quantities has a remarkable effect upon the physical properties of ordinary steel, which is made up of three constituents: cementite, which is hard and brittle, but has little tensile strength; pearlite, which is strong, but not ductile; and ferrite, which has great ductility, but no strength. By regulating the percentage of combined carbon in steel and controlling the temperature and the rates of cooling, the hardness, brittleness, and tensile strength of the finished product may be accurately controlled.

These physical changes take place during certain stages in

the heating and cooling of the steel, which are, therefore, known as the critical stages. By carefully observing steel while cooling, metallurgists have found that at certain temperatures the rate of cooling is not only retarded, but the mass of iron, apparently in and of itself, generates heat. The generation of this heat is due to the physical changes which are taking place at that particular temperature.

If steel is permitted to cool slowly its crystals are large, and the cool metal is soft. If steel is cooled rapidly, its crystals are smaller, and the steel is hard. In handling large castings, however, it is not possible to cool the entire body rapidly, because the iron must cool from the outside. If a large casting is plunged into an oil bath, it becomes hard on the outside but remains soft inside. The rapid cooling of the outside, however, sets up strains within the casting which must be relieved by annealing or reheating. The annealing process, if accurately controlled, permits the iron crystals to rearrange themselves so that the strain within the piece is relieved.

Steel Hardening.—Steel may be hardened by heating to a point below its critical stage, and then plunging it into a bath of oil or water. The piece may then be toughened by reheating. The toughening process has an advantage over the annealing process, in that you secure both strength and ductility. Case hardening is accomplished by heating the pieces to be treated in a box packed with powdered carbon in various forms. By this process the outer surface of the iron takes up a certain amount of the carbon in which it is packed, without setting up a condition of strain between the inner and outer parts of the piece.

In conclusion may I point out briefly the effect which certain alloys have upon steel.

Alloys and Their Effect.—Up to 1 percent., the addition of each one-tenth of one percent. of carbon adds 3987 pounds to the tensile strength of steel, per square inch. If carbon is present to the amount of 1 percent. or over, the tensile strength is greatly reduced. Manganese makes the steel roll and forge better, and adds somewhat to the tensile strength. The exact effect of sulphur up to one-tenth of one percent. is somewhat in dispute. Phosphorus adds to the static stresses in steel, but high-phosphorus steel does not resist easily constant jarring and sudden strains, and, therefore, high-

phosphorus steel is satisfactory for building purposes, but is unsuitable for rails. A silicon content up to .75 percent. is beneficial. High-silicon steel tends to resist shocks. The effect of oxygen in steel is harmful. Copper in quantities less than one-half of one percent. has no marked effect. Tin increases the tensile strength of steel, but to a less degree than either carbon or phosphorus. Chromium is a hardening element, while nickel adds to the tensile strength.

Much of the material used in this chapter is taken from "The Making, Shaping, and Treating of Steel," published by the Bureau of Instructions of the Carnegie Steel Co. This data has been supplemented by selections from the following books, periodicals, and official bulletins:

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AMERICAN SOCIETY FOR TESTING MATERIALS

Standard Specifications for Automobile, Carbon, Alloy Steels, and Other Steels.

No buyer of iron and steel products can afford to be without at least a working knowledge of the data contained in the above publications. A thorough study of these volumes amplified by current reading on the subject, will qualify even the inexperienced purchasing agent to buy these products on a more scientific basis.

CHAPTER XXVI

MODERN FOUNDRY SUPPLIES¹

Moulding Sand.—Moulding sand, the medium by which a casting is formed, should have most careful consideration. On it depends the surface, and often the quality of the casting. Too often the foundry buyer selects moulding sand from a nearby pit without carefully considering the quality. This reduces first cost, but often proves expensive in the long run. The source of supply should be the governing feature, rather than the location of the foundry.

Moulding sand is made up of particles of quartz or sand, and a bond of clayey substance forming a thin coating around each grain of sand. This bond determines the quality almost entirely, and should be carefully studied and analyzed.

It is the bond which makes a casting rough or smooth as to surface, and in a great measure affects its density. Sands may be open or dense, depending on the percentage of the bonding substance, but the fusing of the bond will upset the calculations of the moulder. The bond usually has a much lower melting point than the particles of sand. The presence of lime and other impurities is most objectionable. Moulding sand, therefore, should be made up about as follows:

<i>Constituents</i>	<i>Percentages</i>
Silica	80 to 85
Alumina	6 to 10
Iron oxide.....	3 to 5
Lime	under 1

Securing Uniform Quality.—Many deposits of sand contain gravel and small balls of clay. The better producers are therefore erecting plants at the pit to dry, mill and screen their deposit as mined, in order to insure a uniform texture with all particles of stone and clay crushed and thoroughly mixed.

It is possible to improve sand having a high percentage of bond of low melting average by adding sharp silica sand,

¹ Prepared by J. D. Hiatt of the National Malleable Castings Company, Chicago.

which is free from any bond. This produces sand having more open grain structure.

Moulding sands are obtainable in most parts of the country, and while good sands may be found in any one territory, the quality of the bonding property seems to average about the same in each locality. New Jersey and Ohio are good examples of localities favoured by nature in the refractory quality of the bond in their natural sands. The presence of many foundries in those territories has proved a great incentive to the development of the moulding sand industry.

The prime requirement in the purchase of moulding sand is to watch the bonding element, and as far as possible, to exclude the worthless impurities which might nullify the good to be obtained from the silica content.

Coke.—Until about twenty-five years ago coke, as known to the foundry, was produced from beehive ovens, and only in the past five years has that type of oven been displaced in percentage of production by the type known as by-product. The foundryman may, therefore, choose between these two grades—the silvery fingered structure of the beehive coke, inheriting many of the impurities contained in the coal from which the coke was produced; and the black spongy appearing product of the by-product oven, from which much of the objectionable content of the coal has been eliminated. Equally good results may be obtained in the cupola with good grades of coke made by either process, but there is much in favour of the by-product coke, because the fracture gives a uniform lump of possibly four or six inches, cubical measure, instead of long irregular splinters which separate into smaller pieces of the same shape under shock. The by-product coke, therefore, makes the better bed in the cupola. With a thick, even bed of cubes, which do not pack tightly, separating the charges, good melting time should be attained and the cost of the fuel may be figured accordingly.

Fire Brick.—*Cupola practice.*—In the selection of refractories for cupola lining, it is necessary to bear in mind the fact that there are two distinct zones of action in a cupola; one being the melting zone, the other the abrasion zone. In the upper part of a cupola where the pig iron, scrap, and coke come in contact with the fire brick there is a certain amount of heat, but its effect on fire brick is negligible as compared with the abrasion from the stock as it moves down through the

cupola. Therefore, in selecting a fire brick for the top portion of a cupola, it is highly advisable to secure one of reasonable refractoriness, but chiefly one that is very strong physically, and that will resist, as much as possible, the abrasion of this stock. The best brick for the top portion of a cupola is a top quality blast furnace brick, which is manufactured from finely ground fire clay, containing a large percentage of plastic clay. The brick must be burned very hard.

In the lower portion of the cupola, there is, of course, a certain amount of abrasion as the stock in a semi-molten state moves down from the upper portions of the cupola, but the chief requirement of the fire brick is its ability to withstand the high temperature attained in the melting zone. For this purpose it is desirable to use a brick which is manufactured from highly refractory clays, containing a small percentage of plastic clays. They should be ground fine and burned at a high temperature in order to produce a good, strong bond.

Malleable Furnace Practice.—For the lining of the side walls and bungs of a malleable furnace, two distinct types of brick are required. A successful bung brick is one that will withstand extremely high temperatures, and resist the tendency to spall or break off in pieces because of the sudden changes in temperature to which this brick is subjected. Such a brick should be coarse, open-grained in structure, and of a rather light burn. It has been found in the majority of cases that a brick of such a structure will best withstand bung conditions, providing of course, it has the proper refractory limit.

In the side walls of a malleable furnace, conditions are much different from those in the bungs; here the brick has to withstand high temperatures as well as the chemical action of the metal and the erosive effect of the slag. It has, therefore, been found advisable to use a brick somewhat denser in structure, and harder in burn than that used in the bungs. The refractory qualities of the side-wall brick should, however, be as high as possible.

CHAPTER XXVII

CHICAGO ELEVATED: STORES DEPARTMENT¹

Organization.—The Chicago Elevated Railroads include four railroads, each operating as a separate company, and keeping separate accounts. There are four storerooms, each in charge of a storekeeper, and three storage yards. The stores department clerical force for all roads is located in the office of the general storekeeper. The general organization plan of the purchasing and stores department is as shown on the organization chart.

Duties.—It is the duty of the stores department:

1. To keep on hand at all times a sufficient supply of materials to meet the requirements of the various departments of the railroad, to receive and check deliveries, store and safely care for, account for, and disburse on requisition only, all materials.
2. To keep the stocks of various materials at a minimum in order to keep the amount of the investment down, and to make the annual turnover as large as is consistent with safe and economical operation.
3. To coöperate to the fullest extent with all other departments and give maximum service.
4. To report promptly for disposition any materials which may have become obsolete because of change of standards, or of which the stock is too large.

Great Variety of Materials.—It must be remembered that on a railroad system like ours, where there are various types of motors, electrical equipment, cars, etc., for which repair parts must be available, a great variety of materials are required. Most of these parts are more or less special, and a railroad storekeeper cannot always work on a definite schedule, as might the storekeeper in a manufacturing concern, where a definite manufacturing program is outlined. Close coöperation between the stores and other departments is therefore of prime importance.

¹Written by E. E. Kretschmer, Purchasing Agent, Chicago Elevated Railroads, and First Vice-President, Purchasing Agents Association, Chicago.

For Record Purposes.—Each of the many thousands of items used is given what we call a "railroad lot number," in other words, what might be called our own "catalogue number." Each item of material is assigned to a certain "CLASS" of material. The various "classes" of materials are shown on Form JB-206A. In classes 125 to 133 inclusive, which are all roadway materials, each class has its own series of "railroad lot numbers." For example, Class 125 is assigned R. R. Lot No. 1 to 25. Class 126 would have R. R. Lot No. 26 to some other figure, and so on, depending upon the number of items in each class. Classes 134 to 158 inclusive, which include a great many small items, are each assigned lot numbers, beginning with one (1).

We here prefix the number with a letter. Letter "A" would designate Class 134, "B" Class 135, "C" Class 136 and so on. In other words, our lot number A1 would classify the material as being in Class 134, Lot No. 1. In Classes 125 to 133 the lot number itself designates the class of the material. In the remaining classes, the letter prefix classifies the material. It is necessary in Classes 134 to 158 to begin with No. 1, otherwise the railroad lot numbers would run into four and five figures, and it would be difficult to maintain a properly divided series of numbers.

Convenience in Receiving.—The larger items of material are received and unloaded and stored in our storage yards, which are convenient to steam railroad connections. All other items are in the storehouse or storehouse yard, which is adjacent to the repair shop of the individual road.

In the storeroom, all materials belonging to a certain class are stored in the same series of shelving. Each compartment of this shelving is carded or tagged, showing lot number and description of the material. The compartments are numbered consecutively, as far as possible.

To follow the system through, it will be necessary to make use of various printed forms. We will take an item of material and follow through the routine from the time the storekeeper orders it to the receipt, storage and accounting in the stores department. We will then disburse some of the same material from the storeroom, and follow through the accounting until it is charged to some operating or some other account and credited to the storekeeper's account. All materials received are charged to the storekeeper's account, and

are held there until disbursed for use to some other account.

We will take for example an item of W. H. 109 Motor Axle Bearing, Pattern 4393, which will be followed through the system.

Storekeeper's order.—*Form J-31.*—This form is made up by the storekeeper in triplicate, all copies being forwarded to the general storekeeper's office, where the storekeeper's requisition number is assigned, and quantities are checked against past consumption, as shown on Ledger Sheet, Form JB-380. If correct, it is approved by the general storekeeper, the original copy being forwarded to the purchasing department, the duplicate retained by the general storekeeper, and the triplicate returned to the storekeeper.

This form is also used by the operating departments in ordering special materials. They then make an extra copy for their own files, and assign their own department number for record. After the storekeeper's requisition (Form J-31) has gone through the routine, the purchasing department's purchasing order is placed, a copy of this purchasing order being forwarded to the general storekeeper and to the storekeeper of the road concerned.

These copies of orders are filed in the stores department alphabetically until the completion of order, when they are filed numerically in binders for future reference. The storekeepers record the purchase order number on their copies of Form J-31.

Form JB-358.—This card is kept in the storekeeper's file. He makes a record on this card each time he places an order for this particular material. This card is also a guide to the demand for this particular item of material, and the approximate quantities to order.

Receipt of Materials.—*Receiving Memo.*—*Form J-341 (numbered in duplicate).*—After a shipment is checked, this form is made out by the storekeeper. The original copy is sent to the general storekeeper's office, the duplicate is retained by the storekeeper, and filed numerically. The storekeeper also makes a record of the receiving memo number on his copy of the purchase order.

All invoices are sent direct to the general storekeeper's office in duplicate. The original receiving memo is filed alphabetically in the general storekeeper's office until the invoice is received. The invoice is then checked with the receiving

memo for quantities and description, and if correct, is certified on the face of the invoice as shown. The original invoice is finally forwarded to the purchasing department for price checking, approval for payment, and forwarding to the auditor as authority to charge the storekeeper's account, and vouchered for payment. The duplicate copy is retained in the general storekeeper's office for entry in the stock ledger (Form JB-380), and then filed numerically.

The receiving memo number and date is also recorded on the general storekeeper's copy of the purchase order, and then both purchase order and receiving memo are filed numerically.

Receipt of Material.—*Form JB-384.*—Notice from storekeeper to operating department. This form is used only where special materials are ordered by other departments and as general information for those departments when this material is promised for shipment, shipped, or received.

Report of Material.—*Form JB-111.*—This form is used in place of the receiving memo (Form J-341), when car lot shipments are received at the storage yards. All material received in the storage yards is unloaded by the maintenance of way department. This form is also used when material is loaded in the storage yard for out-shipment.

Ledger Sheet.—*Form JB-380.*—These sheets are kept in the general storekeeper's office, filed numerically in binders. The lot numbers serve as the ledger page numbers. On this sheet is recorded the general description of the material, weight, manufacturer's catalogue number if any, pattern number, the unit, the minimum stock and the maximum stock. This sheet also shows when the material was ordered, received, and disbursed, and the stock on hand. The work is all done on a bookkeeping machine.

We have now been through the system of ordering material for stock, and accounting for it until it is charged to the storekeeper's account. We shall now disburse nine pairs of W. H. 109 Axle Bearings, and follow through the system until the storekeeper's account is again credited with the value of the material disbursed.

Requisition on Stores Department.—*Form J-207.*—This is the form of requisition used by other departments for drawing material from the stores department. The form is filled out in triplicate; the third copy is retained by the department requiring the material. The department assigns its own de-

partment letter and number, a different letter being used by each of the departments. The letter and number designate whether it is for the shop, road, or electrical departments.

The original and duplicate requisitions are presented to the storekeeper, who fills the order and inserts the lot number, as shown on the bin from which the material is drawn. The storekeeper then sends both copies to the general storekeeper's office, where they are entered on stock ledger sheet (Form JB-380), under the heading "disbursed."

They are then priced, extended, checked, and entered on the summary distribution (Form JB-138). The original is filed numerically, the duplicate (also priced) being attached to a duplicate copy of Form JB-138. This duplicate copy of JB-138, with duplicate copies of requisition attached, is forwarded monthly to the department head controlling the account. This gives him in detail all materials charged to any one of his individual accounts during the month.

Summary of Distribution.—*Form JB-138.*—This sheet is made up in duplicate in the general storekeeper's office, a set being made up for each account, showing the totals of each requisition charged to that account during the month. The original copy is filed in the general storekeeper's office; the duplicate goes to the department head responsible for the account. From this form, it is possible to locate by number all requisitions chargeable to any individual account during any month.

Monthly Distribution.—*Form JB-241.*—This form consists of five sheets showing the various accounts. (See page 238.) This is made up in the general storekeeper's office, and is a complete summary of the totals as shown on Form JB-138 for each account. The original is forwarded to the auditor who credits the total amounts shown to the storekeeper's account, charging the various operating accounts, plus a percentage to cover the storehouse expense.

Monthly Stores Department Ledger Report.—*Form JB-206A.*—This report is made up in the general storekeeper's office, and is a monthly recapitulation of the ledger class control sheets. For the ledger class control sheets, a copy of Form JB-380 is used, on which is recorded daily in money value only the debits and credits for the class of material. This information is transferred to Form JB-206A at the end of the month.

The report is valuable because it analyzes the amount of funds tied up in each class of material, and also shows the monthly turnover in the various classes. This report also must agree with the auditor's report of total debits and credits to the storekeeper's account.

The purchasing department compiles a report showing the various classes of materials and the money value of each of the classes on the first of each month. This shows a monthly comparison all on one sheet, that is, a report covering a whole year would have twelve columns, and a comparison can be made month against month on any class.

Return Goods Notice.—*Form JB-90.*—This is made out in the general storekeeper's office in triplicate, and covers the material returned to vendors for any reason. It serves both as a shipping notice and a request for credit. A copy of this notice is also forwarded to the purchasing department for their information. This return goods notice, and the credit memo are numbered, and recorded on the receiving memo when the credit memo is received.

Receipt of Car Notices.—*Form JB-348.*—The yard man forwards this form to the general storekeeper. A copy also goes to the maintenance of way department as notice to unload.

Form J-179.—This form is used when any materials are returned by departments to the storehouse, either new or scrap material. It is made in triplicate by the storekeeper, one copy going to the general storekeeper, one copy to the department returning the material, and one copy being retained by the storekeeper. This is notice to the general storekeeper that the storekeeper has received material which should be credited to some other department account, and charged to the storekeeper's account.

Form J-180.—This is made in triplicate by the general storekeeper on receipt of Form J-179. It gives a complete record of material taken into the storekeeper's account, and a copy of the form is sent to the auditor as authority to credit one account, and charge the storekeeper's account. One copy is retained, and the other copy is forwarded as a credit memorandum to the department whose account is credited.

Check Inventory Sheet.—*Form JB-342.*—The stock ledger is a perpetual inventory record, but test inventories

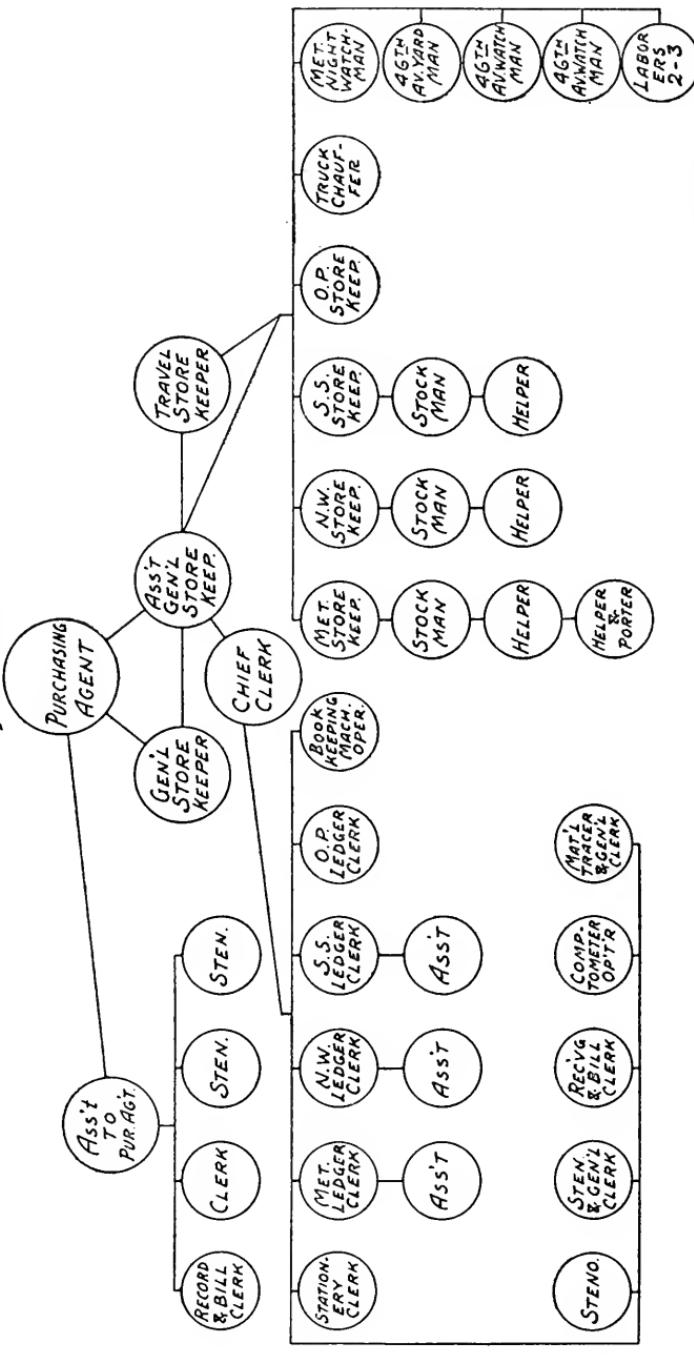
are taken, a few items at a time, continuously, to check the actual material balance in the storehouse against the stock ledger balance.

The purchasing department, in placing orders, shows the R. R. Lot Number for each item, and requests the vendors to show the lot number of each item on their invoice. It is then an easy matter when the ledger clerk receives the invoice, to turn over to the page number in the ledger, which is also the lot number, and make the necessary entries.

Scrap Material.—All scrap materials are turned over to the stores department for credit to a proper account when sold. All sales of scrap are made by the purchasing department, each sale being given a scrap sale number. The general storekeeper receives from the purchasing department a notice of the sale of scrap to a dealer. The material is delivered to the dealer in accordance with the terms of the sale. The storekeeper, with the travelling storekeeper, weighs all scrap as it is delivered to the buyer. A receipt is obtained whenever scrap is delivered. Form JB-73 is then filled out, and sent to the purchasing department as a record of the material delivered on the sale, and the proper accounts are duly credited. The sale of scrap is then formally closed in the purchasing department by the issuing of a scrap sale report giving a complete record of all materials sold under that sale number. A copy is forwarded to all officers interested.

Travelling Storekeeper.—On our roads, one of the duties of the travelling storekeeper is to keep in actual touch at all times with the stocks in the various storehouses and yards, and to keep in touch with the work being done by other departments. If one road is overstocked on a certain item of material, or if they have in stock materials which might not move promptly, and one of the other roads might at the same time need some of this same material, he transfers the material from one stock to another. In that way he helps to keep down the combined stock of the four roads.

*CHICAGO ELEVATED RAILROADS.
ORGANIZATION
PURCHASING & STORE DEPARTMENTS.*



LOT NO. P-285

CATALOG NO.

PATTERN NO. 4393

Form J. B. 358. 30M. 1-20.

FORM J B-358

J. J. D. 100. 1-M-3 4-21

The Metropolitan West Side Elevated Railway COMPANYDate Oct. 9th, 1921.Mr. -----, Shop Dept.

All

Items

Ordered on your purchase requisition No. 685-R Dated 9/5/21
 Promised for Shipment }
 Shipped- } On 10/8/21 From _____ Via _____
 Received }
 Remarks _____

R. HOUSE, Asst. Gen'l Storekeeper,

Per _____

FORM J B-384

Form J B-111 2M 35 11 29

ROAD _____

REPORT OF MATERIAL

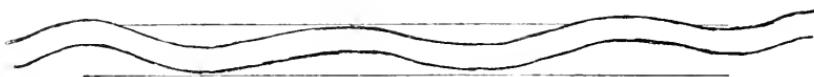
DATE 1921TO ENGINEER,
MAINTENANCE OF WAY:

I HAVE TODAY _____ LOADED AT _____

THE FOLLOWING MATERIAL:

CAR NUMBER _____ CONTENTS _____

MATERIAL CHECKED AS FOLLOWS:



MATERIAL _____ LOADED BY _____

CONTENTS INSPECTED BY _____

(SIGNED) _____

FORM J B-111

Form J-B-241. SAC 10-16

Series F

MATERIAL DISTRIBUTION

COMPANY

MONTH OF _____

19____

	ACCOUNT	MATERIAL		STOREHOUSE EXPENSE	TOTAL
		DETAIL CHARGE	CONTROL		
MAINTENANCE OF WAY-ROAD					
4	Ballast				4
5	Tie				5
6	Rails				6
7	Rail Fastening and Joints				7
8	Progs, Switches and Special Work				8
9	Guard Rails and Timbers				9
10	Cable Boxes and Footwalks				10
11	Signal and Interlocking Systems				11
12	Removal of Snow and Ice				12
13	Other Roadway Expenses				13
	Special				
	"				
	"				
	"				
MAINTENANCE OF WAY-ELECTRICAL					
14	Conductor Rails				14
15	Overhead Trolley				15
16	Feeder System				16
17	Return Circuit System				17
18	Telephone and Telegraph				18
19	Other Distribution Expenses				19
	Special				
	"				
	"				
MAINTENANCE OF STRUCTURE					
20	Foundations				20
21	Repairs of Structure				21
22	Painting Structure				22
23	Other Structure Expenses				23
	Special				
	"				
	"				
RIGHT OF WAY					
24	Paving and Cleaning				24
25	Crossings, Fences, Signs, etc.				25
26	Lighting Highway and Yards				26
27	Other Right of Way Expenses				27
	Special				
	"				
BUILDINGS, FIXTURES AND GROUNDS					
28	Station Buildings				28
29	Storage Battery Buildings				29
30	/31 Rotary Station Buildings				31
32	Machine and Repair Shops				32
33	Other Buildings				33
34	Water System in Yards				34
35	Electrical Maintenance of Buildings				35
36	Other Expenses				36
	Special				
	"				
Total Maint. W. S. & B.					
CARRIED FORWARD					

CHICAGO ELEVATED: STORES DEPT. 239

Form J-B 206, I.M. 6-26

THE METROPOLITAN WEST SIDE ELEVATED RY. COMPANYSTORE DEPARTMENT LEDGER REPORT FOR MONTH OF AUGUST 1921

CLASS NUMBER AND DESCRIPTION	ON HAND <u>JULY</u>	RECEIVED	DISBURSED	CREDITS	ON HAND <u>AUG.</u>
125. Ties	15,570.85	3,867.69	3,697.49		15,741.05
126. Rail					
126A. Rail (Second Hand)					
127. Rail Fastenings and Joints					
128. Fuses, Switches and Special Work					
129. Guard Rails and Timbers					
130. Signal Supplies					
131. Footwalk, Platform and Misc. Lumber.					
132. Station Supplies					
133. Misc. Maintenance of Way Material					
Total Value Maint. of Way Material					
134. Glass, Palates, Painters' Supplies					
135. Air Brake Material, including Components and Gaskets					
136. Insulating Materials and Palates					
137. Carbons					
138. Bolts, Nuts, Screws, Bolts, Screws, Washers					
139. Car Brake Equipment, including Car Brakes and Piping					
139A. Control Apparatus Repair Parts					
140. Miscellaneous Car Material					
141. Air Hose, Packing, Gaskets, Rubber Supplies					
142. Porters' Supplies					
143. Extra Lamp, Lantern, Battery, Lamp Lenses					
144. Electrical Supplies					
145. Drugs and Chemicals					
147. Light and Heavy Hardware					
148. Dry Goods and Cordage					
149. General Store Lotions, Soap, and Cleaning Supplies Deposits, Ice, Coal, Ashes					
150. Pipe and Pipe Fittings					
151. Rail and Iron Garage, Iron Sheet, Tin Sheet					
152. Oil, Waste, Greases					
153. Tires, Wheels, Axles, Gears, Pinions					
154. Special Material					
155. Misc. Supplies (common to all depots)					
156. Brads, Tacks and Pins for Supplies, including Rail Brads					
157. Wire, all kinds					
158. Carbons, Resols and Cement Backs					
Total					
A. P. E.					
Grand Total					

REMARKS:

CORRECT: _____

LIPPER CLEAR

APPROVED: _____

B. C. BREWER

Form J B-90. EM. 6-21

414 South Throop Street
CHICAGO

On _____ we returned via _____ to your Company

for credit the following items:



Returned account of _____
 Please send credit memorandum in duplicate to General Storekeeper, 414 South Throop Street, at your earliest convenience.

General Storekeeper.

FORM J B-90

Form J. B. 944. EM. 6-21.

ROAD

Date _____

MR. F. F. McCALL,
General Storekeeper.

Dear Sir:

The following car was received at _____ yard this date.

Car Initial _____ No. _____

WEIGHTS: GROSS _____ TARE _____ NET _____

Contents _____

Condition of Seals _____

Condition of Car _____

Form J B-348

CHICAGO ELEVATED: STORES DEPT. 241

卷四-178-162-0312-12-A51n-(32)-4-32

THE METROPOLITAN WEST SIDE ELEVATED RAILWAY COMPANY.

TO GENERAL STOREKEEPER.

No. _____

The following Material has been RETURNED this date

	CREDIT ACCOUNT

Digitized by srujanika@gmail.com

STORZ

FORM J-179

Form 2, 160. 350 sets in Trip 39. 1-21.

THE METROPOLITAN WEST SIDE ELEVATED RAILWAY COMPANY.

Storekeeper's Credit Memorandum

Vol. 3396

79

DATE _____ 123

SHARON ZD

REVISED N.

Friends of Depression should pursue the **Crusade** to **America** for your **social** **economics** **plan**.

OCTOBER

REMOVED

General Structure

FORM J-180

FORM J B-342

Form B 73-135-9-12

SCRAP DELIVERY TICKET

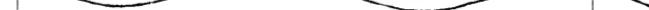
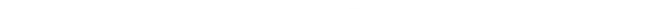
Date _____

The following items of scrap material have been delivered to

— this date.

Wagon Load No. _____

Total Weight _____ lbs.

WEIGHT	DESCRIPTION OF MATERIAL	CREDIT TO
		
		
		
		
		
		
		
		
		
		
		
		
		
		
		
		
		
		
		
		
		
		
		
		
		
		
		
		
		
		

Storekeeper.

FORM J B-73

CHAPTER XXVIII

SALVAGE NOW A SCIENCE¹

The Importance of Salvage.—To the average purchasing agent there may not seem to be any necessity for devoting much time and study to the handling and disposal of salvage and scrap materials. In the war years, and those that immediately followed, there was a well organized propaganda for the conservation of materials of all kinds. Materials of every description became so scarce that, even with the greatest economy, some plants were not able to secure all they needed. After the necessity for this strict rationing of materials had passed, many of the larger plants found that they had set up an organization for the handling and the economical salvaging of materials that had resulted in huge economies.

The amount of money that may be saved by the scientific handling and disposal of by-products, and salvage and scrap materials, may be partially realized when you learn that the introduction of the scientific handling of this material resulted in savings totalling more than \$80,000, in a single automobile plant in Detroit in 1921.

Food for Thought.—It is quite possible that all of these scrap materials produced by your particular plant are handled in the most economical manner, and disposed of to the best possible advantage. It would, however, be rather surprising if you did not at least find food for thought in the following discussion of this important part of the duties of the purchasing agent, which was prepared by Earle A. Mann, a former assistant purchasing agent with the Steel and Tube Co. of America, later with the General Motors Corporation, and now engaged in the handling of industrial by-products.

Some of the economies effected by Mr. Mann are most unusual. Unfortunately, it is not possible to give the reader

¹ Prepared by E. A. Mann, Industrial Engineer, formerly in salvage division, General Motors Corporation.

the details of the cases involved, because this is confidential data. The savings effected for one large interest totalled nearly a quarter of a million dollars in the first two years.

Read the chapter on this most interesting subject, and then go back to your desk, and see if you can't study out a new and improved method of handling some of this material that will result in a saving of at least a few hundred dollars each year. If you cannot do this, either your plant is one in a thousand, or you lack the vision to see the opportunities that lie at your feet.

Salvaged Material.—In taking up the question of salvaged material, we will start with what might be termed the by-product division of the purchasing department. The word by-product is used in order to distinguish this class of material from the primary product which the company manufactures. In other words, a manufacturing company makes two classes of material: First, their primary product, or that material which they are incorporated to manufacture; second, that material which is left after the primary product is manufactured, and which is commonly known as scrap, although, in order to operate economically and efficiently, the material should be known as by-product material, and taken through the stage of salvaging or reclamation before it gets to the stage of scrap.

In common usage, the words salvage and reclamation are synonymous. In reality, there is a very distinct difference.

Salvage.—Salvaged material is that material which is thrown out of the line of production by the inspectors because of some minor defect, which material can possibly be repaired and put back into the line of production, or used in some other way by the company. An example of this would be the cylinder head in an automobile plant, in which one of the holes might be drilled one-sixty-fourth of an inch off center, which, so far as the production department is concerned, would be sufficient to throw the cylinder head out of the line of production. However, this hole can be welded shut and another hole drilled in the proper location, thereby enabling the cylinder head to be put back into production instead of being scrapped. This would be termed the salvaging of material.

Reclaimed Material.—Reclaimed material is that which, from the viewpoint of the production department, is scrap,

but which, from the view point of the by-product division, can be used by someone else; either *as is*, or converted into something which someone else can use. An example of this might be the small pieces of leather which accumulate in a furniture factory or an automobile trim shop plant and which from the point of view of that plant are too small to be used further by them. They are therefore thrown out of production, and considered as scrap by the production department.

However, most of this material can be reclaimed, and sold to novelty manufacturers, where it is used for such things as children's pocketbooks, saddles for toy horses, collars for toy dogs and the like. This would be termed reclaiming material.

Actual Scrap.—The third class of work to be handled by the by-product division, is that material which is actually scrap. Scrap material is that which cannot be used by anyone unless it is first put through a process of disintegration. For example: a piece of iron, steel or metal, must go through the process of remelting or refining.

In determining whether material is scrap, there are four questions you should ask yourself: (1) Can the material be used "as is" by any department of your own plant or your allied companies? (2) Can the material be used "as is" by any one else? (3) Can the material be re-worked into something which can be used in some department of your own plant or your allied companies? (4) Can the material be re-worked into something which can be used by someone else?

If it cannot be used "as is," or re-worked into something which can be used, then it is scrap.

Not Scrap but By-Products.—So far as your scrap foreman and workmen are concerned, it is an excellent idea to discontinue the use of the word "scrap" as far as possible, because to the average mind the word "scrap" means something of no value, or in other words "junk," and something to be got rid of.

If you can instill into the minds of your foreman and workmen the fact that everything has some value and get them to think of this material as a by-product instead of scrap, you will have got a good start along the road towards saving money for your company.

Now let us take up the three classes of material handled by the by-product division; namely, salvaged material, reclaimed

material, and scrap, and determine how these three classes of work can best be handled.

Salvaged Material.—Rightfully, the salvaging of material, as designated above, should be done under the direction of a production department of your plant. The reason for this is that the production department is the place where the material is spoiled. They should, therefore, have the opportunity to salvage that material, and get it back into the line of production, where it can be used in their own work, thereby getting credit for it, instead of having it charged against them. If this material were turned over to the by-product division, salvaged by them, and then turned back into production, the entire loss would be carried against production and credited to by-products.

If your plant is too small to maintain the salvage department under the production department, it is entirely satisfactory to put it under the by-products division, and work the salvaging of material right along with the reclaiming of material.

Keeping Check on Material.—Should you desire to handle the salvaging of material in the by-products division, the production department will send all such material to the reclamation department on the proper kind of a transfer ticket, showing just what is wrong with the material.

The reclamation department will then determine whether the material can be salvaged and put back into the line of production. If so, the proper work will be done, proper records kept according to your cost accounting system, and the labour and material charged against the production department.

The material will then be returned, either to stock or to the production department, as the case may be, with proper records so that it gets back into the books of the company. Where it is impossible to salvage material, it then goes through the process of reclamation.

Reclaimed Material.—The reclaiming of material must be worked so closely in conjunction with the actual scrap classification of material, that I will make no attempt to detail the reclaiming of material as kept by the proper classification of scrap. For example, in our scrap classification, you find that imitation leather and leathers are sorted into two sizes; one size which must be sold as scrap, while the other size can be

sold as reclaimed material. Another example is the new sheet metal clippings. You will find that any piece of sheet metal out of which a five-inch circle can be cut, is kept on one side, segregated according to size and gauge, and kept under cover and free from rust. The balance of the sheet metal clippings are put through the hydraulic compressor to be put in hydraulic bundles and sold as scrap.

Use Your Imagination.—In order to handle properly the reclaiming of material, one should be able, first, to dream intelligently, and then to visualize. By dreaming, I mean that one must be able to use his imagination very liberally; and by intelligently, I mean he must hold the use of his imagination down to a practical basis. By being able to visualize, I mean that he must be able to see material, not as it is, but as it can be.

For example, when you go out into the yard, and see a large pile of scrap lumber which a receiving department has torn apart and taken off in-coming material received, and which ordinarily is either sold as kindling or taken to the boilers and used as fuel, you should be able to see this pile of lumber, not as scrap, but as nice new boxes, turned over to the shipping department for use in shipping your material.

Lumber Reclamation Pays.—This reclaiming of lumber is one of the most startling features of reclamation work, and is about as important from a money-making standpoint as any work in the plant. A higher percentage in dividends can be earned on the investment necessary for the reclaiming of lumber, than in any other phase of the by-product work.

All boxes, crates, blocking lumber, and the like, which come into the plant should be sent to the lumber reclamation shed, which is properly equipped for converting scrap lumber into usable material. This scrap lumber is taken into the shed, the nails cut off, and the boards cut to the size which can be used to best advantage. These sizes are determined from information received from the shipping department as to what size boxes and crates they require, and how many per month.

When this lumber is cut to the proper length and properly prepared for boxes, it is piled neatly according to size, and either delivered to the shipping department in the form of shooks from which to make their own boxes, or the boxes are finished in the reclamation sheds and delivered to the shipping department as needed. It is much more economical to deliver

completed boxes to the shipping department than for them to make their own, but in some instances the storage space in the shipping department will not permit it.

Don't Pull Nails—Cut them Off.—In connection with the reclamation of lumber, never waste time in pulling nails or attempting to salvage or reclaim nails. Simply cut off the end of the board with the crosscut saw and throw that small piece of lumber and the nails away. From actual figures kept, it has been determined that at the present price of lumber, (1921), it costs about one dollar in labour and supervision to reclaim six dollars' worth of lumber.

Another by-product in the reclamation of lumber is kindling, which can be sold locally. In some territories it actually pays to prepare kindling for sale, but in most places, if your scrap wood left after making boxes is not readily salable "as is," it is of more value to carry it to your boiler and use it as fuel. Your sawdust, of course, can be used around the plant, or if you have a surplus, it is readily salable.

Disposition of Scrap.—In handling scrap, in almost every plant, it pays to have a man in the yard who takes care of the physical scrap. For convenience, we will call him the by-product foreman. Also, as a matter of convenience, we will call the purchasing department man who handles the by-product from the office, the by-product manager. Scrap material is that which is of no further use in its present condition. It is therefore necessary to sell this material, and the sale will be handled by the by-product manager, either on open market bids or by contract.

From the viewpoint of economy, and for the purpose of taking scrap out of the speculative field, the contract is by far the best arrangement; and from actual figures kept over a period of two years, the difference in the price received on contracts and on open market bids is so slight that the contract is by far the best method of disposing of scrap.

Contract for the Sale of Your Scrap.—There are two trade papers which are accepted as standard: one is the "IRON AGE," published in New York City, and the other the "IRON TRADE REVIEW," published in Cleveland, Ohio. Both of these papers are published weekly, and contain quotations on the various classifications of scrap at such points as Pittsburgh, Philadelphia, Buffalo, Cleveland, Detroit, Chicago. Therefore, if you are located in Toledo, Ohio, or Flint, Mich-

igan, your contract would be based upon the average price of the classification of scrap, as quoted in the trade papers on date of shipment, less the freight charges from Toledo or Flint, to Cleveland, Ohio, less the handling charge of the scrap dealer.

This handling charge depends upon the amount of scrap which you have to sell. It is necessary, of course, to select three or four high-grade scrap dealers to deal with, so you will not have to negotiate with the peddlers or dealers whose reputations are sometimes shady.

Use Car Shipments if Possible.—It is a good policy to have sufficient storage space for handling scrap in carloads of each classification, in order to eliminate the expensive process of hauling the material from your plant. Some plant managers have said it costs nothing to have the material hauled from their plant because the scrap dealer did the hauling.

My experience has been that one never gets anything for nothing, and whatever the cost of hauling, the plant stands the expense in some manner or other.

Another very distinct advantage of the contract is that the scrap dealer with whom you have a contract will furnish shipping instructions ahead of time, so that as soon as you have a car of scrap ready it can be loaded and got out of the plant. This is important during normal times, because scrap accumulates so quickly, and storage space is at a premium.

Planning Shipments of Scrap.—Assuming that you have made contracts with a good reliable dealer, about the 25th of each month, the by-product foreman will report to the by-product manager the approximate amount of each classification of scrap he expects to accumulate during the following month. The by-product manager thereupon gives his scrap dealer this information, and immediately the scrap dealer sends shipping instructions covering the material. It is understood by both parties that quantities are only approximate.

When the by-product manager receives the shipping instructions, he issues regular order blanks used within the plant to have this material shipped out as it is accumulated, and from this point forward, the by-product foreman is responsible for seeing that the material is properly classified, properly loaded so that each carload will have minimum weight, in accordance with the railroad classifications, and that it is shipped in accordance with the desires of the purchaser.

As each carload is shipped, the by-products foreman will give the by-product manager full details—the car number, gross weight, tare weight and net weight, classification of scrap in the car, to whom it is being shipped, to whose account, routing, etc. This information is immediately transmitted to the scrap dealer with whom the by-product manager has his contract, so he can notify his customer that the car is on the way.

Records of Scrap Shipments.—As the material is shipped, the by-product manager should keep an accurate record of the actual amount of scrap shipped, giving the date, car number and initials, gross, tare and net weight; to whom shipped, for whose account, routing, etc.; so that at any time in the future, easy reference can be had to these statistics. No special form is required for these records, as experience has shown that an ordinary record voucher book, such as can be purchased at any stationery store for a nominal sum, is best adapted for this work.

It is not necessary to have any special order blanks or shipping instructions for scrap, but in case the regular system of orders within the plant does not allow a copy of the order and a copy of the invoice to come back to the by-product manager, it should be arranged so that an extra white copy of each may be sent to the by-product manager for his file.

Simple Record Systems.—The by-product manager should keep in his office a copy of the records and shipping instructions, against which is attached a copy of the order, and against this is attached a copy of the invoice to show that the transaction is completed.

These invoices can then be filed according to month, and according to the class of scrap shown thereon, so that at the end of each month, when it is desirable to know how much of each kind of scrap has been shipped per month, and the amount of money received, it is only necessary to take an adding machine total of invoices under each classification of scrap, and add the entire lot to get your grand total of scrap shipped and money received. This saves a lot of bookkeeping.

Keep the Quality Up.—It is the duty of the by-product manager to see that the by-product foreman is thoroughly instructed regarding the classification of scrap. At no time should the by-product foreman allow material other than that sold to be shipped. If your scrap is not properly classi-

fied, kept clean and run uniform, it not only means a bad reputation with the mills, but it means an expense because of rejection, and the necessity of re-shipping, or making allowances in order to get the material taken in. You cannot sell one thing and ship another thing without getting into trouble.

Cost Records.—Unless the cost department of your company is prepared to keep a proper record of the labor costs, supervision, etc., it is desirable and proper for the by-product manager to keep an accurate record of these items, as well as the quantity and quality of material shipped, so that at the end of each month he can show how much it costs his company to handle scrap per ton, and can make comparisons with the previous month. His endeavour should, of course, always be to keep this handling charge down to the minimum.

Only by keeping accurate records can you know where you are going. In the larger plants, we even go so far as to keep the record of the amount of scrap coming out of each division of the production department, so that when we get excessive amounts of scrap from certain departments, we can take up the matter with them and help them to determine the causes.

We have found in shop practice as a rule, that the cause for excessive scrap out of a certain department is either improper inspection of material as it is received in the plant, or green workmen. If it is improper inspection, this can be easily corrected, and if it is green workmen, we must expect a certain amount of excessive scrap at first.

Classification of Scrap.—There are four general classifications of scrap in industrial works:

1. Iron and steel scrap.
2. Non-ferrous scrap, such as aluminum scrap, brass, copper, bronze, etc.
3. Trim shop scrap, such as leather, imitation leather, duck, drill, buckram, etc.
4. Miscellaneous scrap, such as barrels, glass, etc.

All scrap removed from the various parts of the factory to the by-product shed should be removed on transfer tickets, showing the class of scrap and from what department it is sent. These tickets will be filed according to departments in the by-product shed, to permit comparisons with the amount of scrap coming out of each department from month to month.

It is not economical to attempt to sort scrap after it has been received at the by-product shed, and it will therefore be

the duty of the by-product foreman to see that the scrap comes to him properly classified from the several departments of the plant. When he does receive mixed scrap, he will take the proper steps to remedy this condition.

Keep the Scrap Clean.—It is also the duty of the by-product foreman to see that scrap is kept clean. By the word "clean," we mean that it shall be free from all foreign substances, such as soap cans, tobacco cans, old gloves, rags, and the like, and that the salvage department separate assemblies containing more than one class of scrap.

In other words, brass, aluminum, bronze, babbitt, etc., should not come attached to pieces of steel, malleable iron, castings, etc. In such cases, where it is not economical to dis-assemble a part which contains possibly a brass bushing in a piece of cast-iron, the entire piece of scrap will be put into what is known as miscellaneous scrap and disposed of as such.

The by-product foreman must be held responsible for the proper classification of scrap, as well as its cleanliness. It is up to him to make and maintain for your company a reputation with the steel mills and foundries, which is of the best.

The by-product foreman will report to the by-product manager his labor costs, so that the by-product manager can analyze this item, and compare it at regular intervals in order to reduce the cost per ton of handling scrap from month to month.

Iron and Steel Scrap.—Iron and steel scrap will be properly segregated in the scrap bins provided, and everything which can be properly placed under a specific classification will be put in the proper bin, in order to eliminate, as far as possible, miscellaneous iron and steel scrap. Miscellaneous iron and steel scrap must be sold to local dealers, who will ship it into their own yards and prepare it further for steel mill or foundry consumption. The seller should endeavour to do this separating himself as far as it is economical to do so.

The Classification of Iron and Steel Scrap.—*Heavy Melting Steel.*—In this classification can be put all pieces of heavy steel which are three-eighths inch and over in thickness, five feet and under in length, and not over 18 inches in width; or in other words, what is known as "charging box size." The minimum weight should be ten pounds and the maximum weight 300 pounds, to any one piece.

Shovelling Steel.—In this classification can be all steel not taken in heavy melting steel classification, which is one-fourth inch and over in thickness and not over eight inches long.

Drop Forge Flashings.—These flashings are the trimmings from steel forgings, and for economical sale, should be separated into two classes: those flashings which are eight inches and shorter, and those which are over eight inches long. The shorter flashings will usually bring a better price than the long ones, or long and short mixed.

No. 1 Busheling.—This classification consists of clean wrought iron and soft steel pipes and flues, tank scrap and bands, boiler plate punchings and clippings, soft steel and iron drop forgings and trimmings. Nothing in this classification may be less than 12 gauge, nor over eight inches long or wide.

No. 2 Busheling.—This classification will take such material as is not classified, under number one busheling, such as cut tubes, sheets, ties and similar light weight material. Nothing must be over eight inches long or wide.

Cast Iron Borings.—Cast iron borings are the borings from cast iron castings, and must be free from dirt, other metal, and lump.

Heavy Steel Turnings.—These shall consist of wrought iron and soft steel turnings, very heavy and short, such as come from the first and second cuts from axles and heavy forgings.

Short Steel Turnings.—This consists of wrought iron and soft steel turnings, which are short enough to be shovelled easily, and not tangled.

Machine Shop Turnings.—Ordinary wrought iron and soft steel turnings, such as come from ordinary machine shop practice.

Mixed Borings and Turnings.—This shall consist of small turnings and drillings in the ferrous line where it is not practical or possible to separate the borings from the turnings.

Hydraulic Sheet Clippings.—This classification will include only new, clean, black steel scrap, such as sheet clippings, stampings, etc., compressed into a bundle by a hydraulic compressor. The bundles must not exceed 18 inches in any dimension.

Loose Sheet Clippings.—This material must be new, black sheet steel scrap, not over five feet long or 18 inches wide, and must be loose to permit easy unloading. Any pieces that

will cut into 5-inch circles or larger, should be sorted into sizes and gauges, kept clean, and sold as reclaimed material.

Hydraulic Galvanized Clippings.—This classification will be the same as the hydraulic sheet clippings, except that it is to contain galvanized scrap instead of new black scrap.

Galvanized Loose Sheet Clippings.—This classification will be the same as loose sheet clippings, black, except that the scrap is to be galvanized.

Hydraulic Tin Plate Clippings.—This must be the same as hydraulically compressed sheet clippings except that it is to be tin plate instead of black.

Loose Tin Plate Clippings.—This classification is the same as loose sheet clippings, except that the scrap is to be tin plate.

Cast Iron Wheels.—This classification will include all solid cast iron wheels, either locomotive or car.

Built-up Wheels.—This classification will include all kinds of built-up or steel-tired wheels, either locomotive or car.

Solid Wheels.—This classification to include all solid rolled, forged, or cast steel wheels, either locomotive or car.

No. 1 Wrought Iron Scrap.—This classification includes principally clean wrought iron from railroad equipment, in pieces six inches long and longer, and one-quarter inch thick and heavier.

No. 2 Wrought Iron Scrap.—This classification includes wrought iron and soft steel, six inches long and that which is not specified in No. 1 wrought iron scrap. This will include such material as bolts and nuts, rivets, spikes, etc.

Malleable Scrap.—Includes all kinds of malleable castings, no piece to weigh more than 150 pounds.

Annealing Pots.—Worn out annealing pots from malleable iron foundries. It is usually advisable to have the scrap dealers inspect this material in order to get the best price.

No. 1 Cast Iron.—This classification shall consist of cast iron scrap of good quality which possesses evidence of having been machined, such as planed or turned surfaces, bored or drilled holes. It must be not more than 150 pounds to a piece in weight, and must not exceed 24 inches in any dimension.

Heavy Breakable Cast Iron Scrap.—This class of material may contain either cast iron machinery, or machine grade cast iron in unbroken condition, but suitable for breaking under a drop hammer; or such cast iron scrap as columns, pipe,

plates, etc., which can be broken under a drop hammer. This classification is different at different consuming points, and it will be well to have the scrap dealer inspect this material before selling, in order that you may get the best price. For instance, some mills will accept as much as 15 percent. of the total weight to consist of steel attachments, and will take pieces weighing as much as ten tons. Other mills will not accept heavy breakable cast iron which has any steel attachments whatever, and will not accept pieces weighing more than 2,500 pounds each.

No. 1 Stove-Plate Scrap.—This consists of clean stove-plate, and must not contain any malleable iron and steel parts, burnt iron, etc.

High Speed Tool Steel.—This must contain at least 15 percent. tungsten, and should be inspected by the scrap dealer before purchasing, in order to secure the best price.

Burnt Cast Iron.—This will consist of such things as grate bars, annealing pots, and cast iron scrap which has been badly oxidized by burning. This material should be shown before selling.

Die Blocks.—This shall consist of cast iron die blocks not over 18 inches wide or thick, and less than five feet long.

Non-ferrous Scrap.—Method of Handling.—Non-ferrous scrap should at all times be kept under cover, and it is very important that the various kinds of non-ferrous scrap be kept separate. For example, brass borings and turnings should not be mixed with copper; nor should iron, steel, or lead be mixed with copper, brass, aluminum, etc.

The handling of non-ferrous scrap is most economically accomplished by this system: the by-product foreman should provide a sufficient number of boxes or barrels, so that each class of non-ferrous scrap can be kept in a separate container. Before any material is placed in a container, the container, including the cover, should be weighed empty, and the tare weight should be stencilled on the end of the container. The class of scrap which is to be placed in this container should also be stencilled on the end of the container.

As soon as the container is full of its own kind of scrap, the cover should be immediately secured, and it should be weighed at once. The gross weight as well as the net weight should then be stencilled on the end of the box, and the con-

tainer given a number. These numbers should start with No. 1, and run consecutively.

All of the above information should be placed on the end of the container, so that as the containers are piled on top of each other, the information showing the container number, the gross, tare, and net weight, and the class of scrap which it contains, will be visible. As these containers are filled, they should be piled in a convenient place under cover, and a record of each container with full information should be given to the by-product manager.

The by-product manager will keep a record of these containers, in order to know at all times the quantity of each kind of non-ferrous scrap on hand, and the proper time to make a shipment.

Aluminum borings and turnings should be dried as much as possible and then placed in burlap bags instead of boxes and barrels; otherwise they may be handled as above.

Classification of Non-ferrous Scrap.—The classification covering non-ferrous scrap as adopted by the Waste Material Dealers, Incorporated, is as follows:

Heavy Copper.—This shall consist of copper not less than 1-16 inch thick, and may include trolley wire, heavy field wire, heavy armature wire that is not tangled, and also new copper clippings and punchings, untinned and clean, and copper segments that are clean.

No. 1 Copper Wire.—To consist of clean untinned copper wire not smaller than No. 16 B. & S. wire gauge, to be free from copper wire which is burned brittle, and free from all foreign substances.

No. 2 Copper Wire.—To consist of miscellaneous clean copper wire, such as of necessity would be taken out of the heavy copper and the No. 1 copper wire, but to be free of hair wire, and burnt wire which is brittle.

Light Copper.—Shall consist of the bottoms of kettles and boilers, bath tub linings, hair wire, burnt copper wire which is brittle, roofing copper and similar copper, *free from radiators, brass, lead, solder connections, readily removable iron, old electrotype shells, and free from excessive paint, tar and scales.*

Composition or Red Brass.—Shall consist of red scrap, brass, valves, machinery bearings and other parts of machinery including miscellaneous castings made of copper, tin, zinc

or lead; no piece to measure more than 12 inches over any one part; to be free of aluminum and manganese; also free of railroad boxes, cocks and faucets, gates, pot pieces, ingots and burned brass.

Railroad Bearings.—Shall consist of railroad boxes or car journal bearings; must be old standard used scrap, free of yellow boxes, plastic and similar bearings; also iron-backed boxes. All must be free of babbitt, and excessive grease and dirt.

Cocks and Faucets.—To be mixed red and yellow, free of gas cocks and beer faucets; shall be at least half red.

Heavy Yellow Brass.—Shall consist of heavy brass castings, rolled brass, rod brass ends, brass screws and tinned or nickel-plated brass tubing; to be free of iron and dirt and must be in pieces not too large for crucibles; no piece to measure more than 12 inches over any one part. Must also be free of aluminum and manganese mixtures. Condenser tubes shall not be considered as heavy brass.

Light Brass.—Shall consist of light sheet brass, forks, spoons, and miscellaneous brass that is too light for heavy. Must be free of any visible iron, radiators, gun shells containing paper, ashes or iron, loaded lamp bases and clock works.

New Brass Clippings.—Shall consist of the cuttings of new sheet brass, must be absolutely clean and free from any foreign substances.

Brass Tubing.—Shall consist of brass tubing, free of nickel plating, tin, solder, or tubes with cast brass connections. To be sound, clean tubes, free of sediment and condenser tubes.

No. 1 Composition Turnings.—To be free of aluminum, manganese, plastic and yellow brass turnings, not to contain over 2 percent. iron, to be free of grindings or foreign material, especially babbitt, and free of adulterations made to resemble metal. Turnings not according to this specification will be subject to sample.

No. 1 Yellow Brass Turnings.—Shall consist of strictly rod turnings, free of aluminum, manganese, composition and tobin turnings. Not to contain over 3 percent. of iron, oil or other moisture; to be free from grindings and babbitt. To avoid dispute, to be sold subject to sample.

No. 1 Pewter.—Shall consist of table ware and soda foun-

tain boxes, but in any case must test 84 percent. tin. Syphon tops to be bargained for separately.

Auto Radiators.—To be classed separately; must be free from iron.

Zinc.—Must consist of clean sheet and cast zinc, also cast batteries, free of loose oxide and dross, and sal ammoniac cans and other foreign materials.

Tin Foil.—Shall consist of pure foil, free of lead compositions and other foreign ingredients.

Electrotype Shells.—Must be hand picked and free of dross.

Battery Lead Plates.—Shall consist of dry battery lead plates, free from wood, rubber and paper. Moisture must not exceed 1 percent.

New Sheet Aluminum Clippings.—Shall consist of new sheet aluminum and cuttings. Must be free from oil, grease and any other foreign substances. Must be guaranteed not less than 98 percent. pure aluminum.

Aluminum Wire.—Shall consist of aluminum wire guaranteed 98 to 99 percent. pure aluminum, and must be free from corrosion, and any foreign substance.

Painted Sheet Aluminum.—Shall consist of painted sheet aluminum, and must be absolutely free from iron, dirt or any other foreign substance.

Aluminum Castings.—Shall consist of aluminum castings, free from iron, babbitt, brass and any other foreign substance. Must not exceed 2 percent. of oil and grease.

Old Sheet Aluminum.—Shall consist of old and manufactured sheet aluminum. Must be free from painted sheet aluminum, iron, dirt, and any other foreign substance.

Aluminum Borings.—To avoid dispute, should be sold subject to sample.

Aluminum Foil.—Shall consist of pure aluminum foil, free from paper and any foreign ingredients.

Babbitt Metal.—Shall contain bearing metal of all kinds. Shall not contain scrap hard metal, Allen metal (which is copper and lead alloy), die casts, zinc boxes or type metal.

Monel Metal Scrap.—Must be in sheets, clippings, castings, bars, or rods. Must be free of iron and other foreign materials. To avoid disputes, should be sold subject to sample.

Monel Metal Turnings.—Must be free of iron and any undue percentage of oil and moisture. To avoid disputes, should be sold subject to sample.

Trim Shop Scrap.—Scrap material from the trim shop will be properly segregated according to classification, and held in bags or other containers until a sufficient quantity has been accumulated for a shipment.

As this material accumulates, and is placed in containers, the containers will be numbered and tagged, marked with the weight, and reported to the by-product manager in the same manner as non-ferrous scrap.

The classification covering trim shop material is as follows:

Buckram.—Buckram cuttings of all sizes and shapes—baled.

Burlap.—A. Sizes one square yard in area and over, clean and suitable for re-use, must be of uniform grade—baled. B. Soiled and torn pieces of any size, including worn-out bagging—baled.

Carpet.—A. Carpet cuttings 4 inches x 9 inches and larger of clean stock in bags. B. Carpet cuttings smaller than 4 inches x 9 inches or soiled larger pieces—baled.

Celluloid.—A. Pieces 5 inches x 10 inches or larger of uniform thickness that are free from scratches. B. All small cuttings under 4 inches x 10 inches and soiled or scratched larger pieces.

Cotton Wadding.—White or colored wadding and batting free from cloth, leather, tacks, paper, and other foreign matter—baled.

Leather.—A. Clean uniform pieces from which a 4-inch circle or larger may be cut. B. Small leather cuttings under 4 inches in any dimension, including soiled larger pieces—baled.

Fabrikoid.—A. Clean cuttings of uniform grade over 4 inches x 9 inches in size. B. All cuttings under 4 inches x 9 inches and soiled larger pieces—baled.

Rags.—A. White cotton clippings—baled. B. Coloured cotton clippings—baled. C. Re-washed white or coloured rags—baled.

Rubber Top Material.—A. Clean rubber auto top material 4 inches x 9 inches and larger, free from seams, fasteners, celluloid, etc. B. Rubber top cuttings smaller than 4 inches x 9 inches and soiled larger pieces—baled.

Velour Cuttings.—A. Clean cuttings of uniform grade 4 inches x 9 inches and larger. B. Cuttings of all kinds smaller than 4 inches x 9 inches and soiled larger pieces—baled.

Hair.—All hair wadding or pads to be sold upon inspection.

Miscellaneous Scrap. — *Classification.* — Miscellaneous scrap around the plant is all material which cannot properly be classified under iron and steel, non-ferrous, and trim shop. A synopsis of such material follows. There is no standard classification for this kind of material, as it will probably not be the same in any one plant from month to month.

1. *Barrels.* A. Sound, heavy, double-headed barrels that have been used for such material as kerosene, turpentine, alcohol, light oils, etc., and which can be easily cleaned by steaming.

B. Sound, heavy, double-headed barrels that have been used for heavy oils, and greases, paint, enamel, etc., and which cannot be easily cleaned by steaming.

C. Single-headed sound, heavy barrels that have been used for soap, greases, etc.

D. Single-headed clean packing barrels that have been re-used for packing purposes.

E. Sound black barrels.

2. *Belting.*—Used leather belting, any length and over 3 inches wide, that have been worn off.

3. *Cullet.*—Broken pieces of all grades of clear glass under 6 inches square and including strips under 4 inches wide and 18 inches long.

4. *Paper.*—A. Books and catalogues and manila stock—baled. B. Mixed lots of all grades and colours, including strawboard—baled.

5. *Rubber.*—A. Soft rubber free from fabric and attachments of other material, including sheet rubber clippings and tubes, etc. B. Rubber with fabric, such as mattings and hose.

6. *Tires.*—A. Slightly used or damaged new tires. B. Used tires with broken fabric. C. Worn out tires that have been blown out or badly rim cut.

7. Any other items that can be sold for re-use such as bricks, cans, cinders, etc.

CHAPTER XXIX

PROGRESS IN COÖPERATIVE BUYING

Saving Expenses.—Before I became a purchasing agent, I very often thought over the economic possibilities of coöperative buying, or the pooling of the orders of various firms and institutions. If, I argued, the sales expense in any line of business is 10 percent., the consumers could save at least half that amount for themselves if they would coöperate in reducing or eliminating this cost. It is manifestly not possible or desirable to eliminate all the sales effort of the vendors in many lines, but there is certainly a large amount of waste in handling the sales of many business houses. If we could get together and eliminate this expense, we ought to be able to secure for ourselves at least a part of the saving effected in the form of lower unit prices.

The first real progress was made in connection with the Association of American Colleges in 1917, after the following report was presented at the annual meeting held in Chicago:

The Report.—“For generations the purchasing agent, like the small country dealer, has been content to go it alone. He has held aloof because of his fear of disclosing trade secrets, and having the other fellow ‘steal his thunder.’ Of late, however, some purchasing agents have been known to admit that there is really nothing mysterious about the business of buying goods, and some of us have found it very profitable to discuss trade conditions with other buyers. We have finally reached the point where it has been possible to form a National Association of Purchasing Agents, with 21 branches stretching from New York to Los Angeles. The local association has 117 members.¹

“In addition to the associations of buyers of varied lines for the exchange of ideas, many dealers and manufacturers in allied lines have found it profitable to form buying organiza-

¹The 1922 figures are: 35 branches and 350 local members.

tions, jointly to serve many firms who compete for the same market. The associated furniture factories in Grand Rapids maintain a purchasing department in Chicago which charges 10 percent. on all purchases made.

"The clothing manufacturers of New York employ a single purchasing agent. The Biddle Purchasing Association of Chicago and New York has served the hardware jobbers of the country for 40 years, and has served some clients for more than 30 years.

Joint Purchasing Office Suggested.—"I understand that the eleemosynary institutions in many localities effect economies of time and effort by coöperating in the handling of many phases of their work. This enables them to handle more cases with greater speed and less cost. There is even a certain amount of coöperation in the raising of funds, but I know of no city where the purchases of the various institutions have been combined. Is it not fitting that the city that has led in so many other respects should be the first to inaugurate this farther step?

"The best brains of the country are at your disposal in the raising of funds, and in the management of other phases of this work, but many more men of big vision would lend their backing if this farther economy were effected. If business houses find it profitable to combine their purchases, would it not be even more advantageous for educational institutions, with their huge expenditures and limited administrative forces, to set up a joint purchasing office?

Value of Group Experience.—"Experience shows that merely putting through one office all the requisitions for a group of units will effect huge economies by giving all the branches the benefit of the best purchasing experience in the group. For instance, Superintendent A is a good buyer of canned goods. Superintendent B is a good buyer of clothing, and Superintendent C is a good buyer of engine room supplies. By combining the purchases, the three institutions get the benefit of the best buying experience in the three lines. The tabulation of the prices paid by different branches of the same corporation will often show variations of over 300 percent. One of the leading industrial engineers of the country recently reported that the colleges of the country could save \$100,000 per year by standardizing their purchases of stationery alone.

"May I cite a few specific examples of the benefit of centralized buying:

I. Seven years ago we found that by changing the specifications on tennis nets, the life of the nets would be doubled, and the cost reduced from \$36 a dozen to \$16.50 a dozen. This reduced the cost more than 75 percent.

II. For six years two office buildings used a disinfecting spray costing \$1.25 per gallon or \$62.50 per barrel. Upon analysis it proved to be formaline, perfume, and Lake Michigan, costing the dealer 47 cents per barrel.

III. Another janitor supply costing \$1.25 per gallon could be produced for \$2 per barrel.

IV. I venture to say that some of the institutions here represented are today buying liquid soap for a dollar or more per gallon, while the Y. M. C. A. College makes a better soap for 11 cents per gallon.

V. Boiler compound is variously priced from 7½ cents to 35 cents per pound, and is used in Chicago in huge quantities, but the Bureau of Standards experts report that no compound is needed for Chicago water.

VI. The Federal Trade Board recently issued an order against seven varnish houses, because of commercial bribery. Five of these varnish houses are located in Chicago, and at least two of them still enjoy a large institutional business.

VII. Within the last few months I have seen requisitions for an expensive cleaning material which analyzed 92 percent. water and 3 percent. silica—or sand.

VIII. Sweeping compound is a large item of expense in many institutions, but sawdust and water will do the job as well at a fraction of the cost.

IX. A slight change in the car numbers of the Pullman Car Co. reduced the annual charge from \$1,800 to \$75.

X. The cost of drugs, food stuffs, and clothing may be greatly reduced by the intelligent application of the best purchase-information. No one superintendent has the time to find for every purpose the product

which will result in the greatest ultimate economy, and even if he did, why have the same ground covered by a hundred or more individuals, when one could do it as well and more scientifically?

"The economies of coöperative buying are so great and so evident that it must come. The only question is, are you ready for the step?

Where Waste Creeps in.—"The administration of these institutions involves a business of considerable magnitude. You have protected yourselves against loss by fire, theft, and misappropriation of funds; but in many cases the ultimate expenditure of many thousands of dollars is directed by janitors, engineers, and housekeepers, whose only method of selection is the costly cut and try method.

"I venture to assert that a study of your kitchen supplies will show dozens of different kinds of baking powder; a survey of your paint shops will disclose dozens of different kinds of varnishes and paints to be used for the same purpose. Among all these different brands surely one can be found that really gives the greatest value for your dollar.

"Comparatively few individuals can afford to give \$100,000 to educational institutions, but even \$100,000 is soon spent. The proposed coöperative plan will soon save a million dollars, and will then continue to return other millions throughout the years to come.

"Let us establish a central purchasing bureau whose duty it shall be to find that most efficient product and secure it for all the institutions, at the least possible expenditure of time, effort and dollars."

Action on This Report.—Dr. R. L. Kelly, who was at that time the executive secretary, appointed a special committee to study the possibilities of coöperative purchasing for the more than six hundred smaller educational institutions that were members of the Association of American Colleges.

The committee consisted of: Dr. Donald J. Cowling, president of Carleton College; John C. Dinsmore, purchasing agent, University of Chicago; Dr. Kelly and B. Warren Brown, his assistant.

As the purchases of these institutions covered a wide variety of materials, we decided to confine our first efforts to the various kinds of paper products and certain janitor's supplies.

A questionnaire covering these few items was sent to all the members of the Association of American Colleges.

No Uniformity in Materials.—The replies to this questionnaire were received and tabulated at the offices of the Association of American Colleges. It was at once apparent, however, that we must farther reduce our first list of items, if we were to make any headway. It was not possible to make up anything more than a list of the materials covered by the questionnaire, because there were no two colleges that used the same materials. We then sent out a second request, for data and samples of the various kinds of envelopes, letter-heads, examination books, and theme tablets used.

When this data was received, we first examined all the samples of envelopes submitted. While there was a wide variance in the prices, qualities and quantities used, they could be classified roughly as bonds, bondines, and government envelopes. A careful study of the qualities and prices showed that we could purchase for them bond envelopes much better in quality than the average, and nearly as good as the best used, and that we could have them printed and delivered for considerably less than they were then paying. We then sent out a sample of an envelope we could purchase at a right price, and asked them to forward their orders to the office, where they were to be pooled and sent to the envelope mill.

We proceeded in the same manner with other stationery supplies. As a result of this offer, we secured orders for envelopes from 86 colleges in 28 States. The net result of these experiments was that the committee saved these colleges something more than \$1,960 on purchases aggregating \$5,300. In other words, the committee saved the colleges of the country 38 percent. on the purchase price, or a little more than one hundred dollars for every hour they served.

Proof That the Plan Would Work.—This work was all done by a voluntary committee, which had carried it on at considerable cost in time and effort, merely to demonstrate the possibilities of coöperative purchasing. We felt that since the feasibility of this plan had been demonstrated, the colleges should assess themselves in order to continue and expand this work which was no longer an experiment. We called a meeting of the representatives of the Association of American Colleges at Lake Geneva in the Summer of 1918 (July 23-25),

to consider setting up a permanent central purchasing office.

Plan for Coöperative Buying.—The following report was then submitted:

"We have met here in order to accomplish three things. We want to become better acquainted, to point out some of the conditions which have developed in the purchase of educational supplies, and to try to discover a remedy for these conditions.

"It is manifestly impossible for us all to analyze and try out every product which is offered us. It is impossible for each one of us to make the best possible purchase of every material we buy when they number tens of thousands annually. It is possible, however, for us to provide the machinery to do this work for us. In other words, while it is impossible for you to consult each one of us when you have an important purchase to make, it is possible for you to have that data collected and made instantly available.

"Why should I spend time and energy investigating a cleaning powder that the buyer for Minnesota has already analyzed and found valueless?

"Why should you continue to pay a dollar a gallon for liquid soap when I can make a better soap for 36 cents?

"Why should one of us get into difficulties with the Internal Revenue Department, when half of our neighbours had learned of the new narcotic regulations?

"The time is not so long past when the business management of educational institutions was proverbially poor. We are entering upon a period of efficient management of educational institutions, at a time when coöperation and standardization are not only possible, but a vital necessity.

To Build the Machine Needed.—"To coöperate efficiently it is, of course, necessary to build up some sort of machine to handle the work. We are here to consider and determine upon the kind of machine best suited to our needs. There are three possible ways of doing this, assuming that there are 100 institutions that would be immediately interested in the project.

I—We can build up an organization under the direction of an expert who will visit each institution, make a detailed report on the materials purchased, prices paid, system of purchases, use to which materials are put, and recommend changes. We can provide him

with the machinery to tabulate this experience and make it instantly available for the other members of the group. Through him, each one of you could visit every one of your neighbours, and secure the benefit of his experience, while still carrying on your regular duties. This would cost each institution about three hundred dollars per year.

II—We can employ a practical purchasing agent who is familiar with university and college purchases, give him a clerk and an office boy, and ask him so many questions and demand so much information that in self-defense he will have to dig and become an expert. This will cost each one of us a hundred dollars a year.

III—We can drop the whole project and continue to muddle through."

War Conditions Prevented Action.—Without exception, the delegates were interested, but conditions were so unsettled that it was considered inadvisable to take any farther action at that time. Because of the war, and the extra burdens it imposed upon the committee, it was not possible to carry on the experiment, and nothing further was accomplished.

There is a very fertile field here, however, and I feel confident that some sort of coöperative purchasing office for colleges will be set up sometime in the future.

The careful administration of a central purchase bureau for colleges would effect savings of at least \$500,000 per year, or an amount equivalent to the income from an endowment of \$10,000,000. To establish this work permanently, however, requires a man with vision and unlimited patience, together with a long and intimate acquaintance with the "faculty type of mind." He should also have an income of his own, or the equivalent, in the form of an endowment from the more wealthy friends of education.

A full report of the work actually accomplished by this committee may be found in the Bulletins of the Association of American Colleges, Volumes IV and V.

Social Agencies Become Interested.—The second, and at first, the more promising little journey in coöperative buying, was made by the Central Council of Social Agencies. About the time that the Association of American Colleges

decided to let the project sleep until after the war, the Central Council of Social Agencies, a voluntary association of the various eleemosynary agencies and institutions in Chicago, formed a committee on purchases.

At the first meeting of the executive committee, the following brief statement of the possibilities of coöperative purchasing was read:

I have not attended any of your previous meetings but I assume that at least some time has been devoted to the discussion of ways and means of raising more funds for the purpose of continuing and expanding your great work, which means so much to the welfare of the next generation. In my estimation, there is just one thing finer than securing new funds, and that is to make the funds you now have work harder and more efficiently. I cannot tell you how the buying power of your dollar may be increased 25 percent., but I can tell you how this has been done in several other allied groups.

The report of the Purchasing Department of the State of California, dated November 1, 1918, shows a saving of 52.86 percent. over the cost of previous years for a selected group of institutions, and a saving of more than 25 percent. on the total supply expenditures for all State institutions, including building operations.

The Association of American Colleges in 1917 and 1918 conducted an experiment in centralized buying which saved the twenty-six colleges involved more than 38 percent. on the purchases made. The various charitable organizations in Chicago each year spend more than a million dollars for supplies, and the greater part of this money is spent under the individualistic form of purchase.

In one rather large institution they have carried purchasing inefficiency to the nth power. Here they have a series of purchasing committees, each serving for a few weeks only, so that by no possible combination of circumstances may future purchases be determined by past experiences.

This type of purchasing arrangement has other disadvantages. Each committee tries to outdo every other committee, and each covers about the same ground, with the result that the sales people are worn out and feel like taking to the tall timber whenever they see a committee headed their way. The net result is that, all things else being equal, they pay the highest possible prices for the poorest quality goods.

In ordinary times the salesman saves his special bargains for the buyer who will be in a position to place future business with him, and the present shortage of goods merely serves to emphasize this custom. Under these conditions the transient purchasing committee has little chance to make a good purchase.

Can you consistently ask for more and larger contributions when you have not expended past contributions in the most advantageous manner?

Knowing as you do, that each year many small lives are lost because of malnutrition, can you go calmly about the unscientific expenditure of the funds contributed for the purchase of milk?

Can you refuse milk to the hungry little ones, when you have wasted the funds given for the purchase of that commodity?

The Central Council of Social Agencies then authorized the committee to send out a questionnaire, the results of which are included in the following tabulation:

PRELIMINARY QUESTIONNAIRE ON PURCHASING — CHICAGO COUNCIL OF SOCIAL AGENCIES

ORGANIZATION	LIQUID TOILET SOAP			SWEEPING COMPOUND			BAKING POWDER			DINNIECTANTS			BOILER COMPOUND			MILK			VARNISH			COAL			% OF TOTAL PURCHASES DISCOUNTED
	Kind	Quantity per Year	Price	Kind	Quantity per Year	Price cwt.	Kind	Quantity per Year	Price	Kind	Quantity per Year	Price	Kind	Quantity per Year	Price	Kind	Quantity per Year	Price	Grade	Quantity	Where From	Price			
Anti-Cruelty Society	none			none			Rumford's	1 lb.	\$2.00 lbs.	Cornonium	100 gal.	\$1.25 gal.	Rumford's	1,000 gal.	\$4.44-45 gal.	none	none		Lump	30 T.	Ind.	\$6.10	none		
Association House	Soporan	1 gal.	\$1.35 gal.	Perolin, No-more-dust (Now make their own)	3 bbl.	\$3.00	Rumford's	1 lb.	\$2.00 lbs.	Cornonium	25 gal.	\$45.00 bbl.	Rumford's	10 qrs. per day	donated	12 gal.	12 gal.	Flour	12 gal.	81.10 gal.	287 T.	Franklin Co.	\$5.75-5.95	About 2%	
Bethel Home and Maternity Hospital	none			Sweeping Compound Co.	100 lbs.	\$7.00	Rumford's	donated		Cornonium	Not standardized		Rumford's	120 gal.	\$8.50 gal.	(From farm near camp)	Odd kinds	12 gal.	Lump	100 T.	Ill.	\$6.25	Fully 66%		
Chicago Boys' Club	none			Very little used	Royal or Price's	20 lbs.	\$4.50 lbs.	West Distri. Co. contract	none	Weston	20 gal.	\$1.05 gal.	Rumford's	960 gal.	\$8.52 gal. average	American	2 gal.	\$3.00	Coronium	108 T.	Ill.	\$8.10 at mine	75%		
Chicago Commons	none			none	Rumford's	none	Santitas	20 gal.	\$1.05 gal.	Weston	50 gal.	\$65 gal.	Rumford's	1,000 gal.	\$8.42 gal.	Very little used	Pocahontas, Buckwheat	225 T.		88.50-9.50	10% on retail				
Chicago Foundling's Home	none			none	Rumford's	none	Bichloride of Mercury Tablets	3 gal.	\$2.50	Weston	35 gal.	\$103.50 gal.	Rumford's	800 gal.	\$8.50 gal.	none	Mine Run	III.	Ind., Md.	\$7.25	Wholesale price on 75%				
Chicago Hebrew Institute	Commercial	300 gal.	\$1.00 gal.	Own manufacture	Rumford's	12	\$1.00	Calumet	10 gal.	Weston	5 gal.	\$65 gal.	Rumford's	1,000 gal.	\$8.40 gal.	none	Screenings	1,200 T.	Ill.	\$5.20	3.75				
Chicago Maternity Hospital and Training School	Soporan	4 gal.	\$8.00	Have not purchased for two years.	Rumford's	none	"KK"	5 gal.	\$2.50	Calumet	34 gal.	\$1.50 gal.	Rumford's	800 gal.	\$8.40 gal.	none	Lindland supplies	—	—	—	Very small				
Chicago Mills Hotel	none			none	Rumford's	none	Calumet	10 lbs.	\$2.00-3.00	Rumford's	34 gal.	\$1.50 gal.	Rumford's	960 gal.	\$8.52 gal. average	none	No records	—	—	—	About 95%				
Chicago Nursery and Half Orphan Asylum	none			none	Rumford's	none	Depend on kind and market price	none	none	Rumford's	34 gal.	\$1.50 gal.	Rumford's	1,000 gal.	\$8.40 gal.	none	Not Not 3	III.	—	84.50-6.25	None up to present time				
Children's Memorial Hospital	Make Their Own			2 bbls	Rumford's	none	Coronium	1 drum	none	Rumford's	10 gal.	\$1.05 gal.	Rumford's	1,000 gal.	\$8.42 gal.	none	Pocahontas Mine Run	—	—	87.25	—				
Christopher House	Not used			Small amount	Rumford's	100 lbs.	\$2.50 lbs.	Dowson, non-solubles	1,000 qt. or 100 qts.	Rumford's	10 gal.	\$1.05 gal.	Rumford's	1,000 gal.	\$8.42 gal.	none	Eve	125 T.	Ill.	\$6.10 (2)	—				
City of Chicago—Dept. of Health	none			none	Rumford's	100 lbs.	\$2.50 lbs.	Dowson, non-solubles	1,000 qt. or 100 qts.	Rumford's	10 gal.	\$1.05 gal.	Rumford's	1,000 gal.	\$8.42 gal.	none	Various	400-500 T.	Ill.	\$5.50-11.50	Handled by City Controller				
Edwards Sanitorium	none			Use most sawdust	Rumford's	120 lbs.	\$1.15 lbs.	Dowson, non-solubles	1,000 qt. or 100 qts.	Rumford's	10 gal.	\$1.05 gal.	Rumford's	10 gal.	\$1.05 gal.	none	Soft, small egg ind out Anthracite, small coal coke and charcoal	III.	Ind.	\$8.21	—				
Elk Barre House	Savile	15 gal.	\$1.40	Sweeping	Rumford's	20 lbs.	\$1.50	Edelweiss	12 lbs.	Rumford's	10 gal.	\$1.75 gal.	Rumford's	1,200 gal.	\$8.45 gal.	none	Calumet	34 gal.	—	87.25	50%				
Elizabeth M. McCormick Fund	none			none	Rumford's	15 lbs.	\$1.50	Kryton	6 lbs.	Rumford's	10 gal.	\$1.75 gal.	Rumford's	1,440 gal.	\$8.45 gal.	none	Pocahontas	90 T.	Va.	87.25	—				
Englewood Hospital	Make their own			none	Rumford's	15 lbs.	\$1.50	Boought in quantities and soluto-mad	none	Rumford's	10 gal.	\$1.75 gal.	Rumford's	10,000 gal.	\$8.45 gal.	market	Pocahontas	—	—	—	On all except coal and milk				
Elizabeth Muriel Day Nursery	none			300 lbs.	Rumford's	15 lbs.	\$1.50	West & Co.	2 gal.	Rumford's	70 gal.	\$1.75 gal.	Rumford's	70 gal.	\$8.45 gal.	2 gal.	Franklin Co.	125 T.	Ill.	\$6.10 (2)	90%				
Fellowship House	none			Perolin (Now make own—sawdust and oil)	Rumford's	15 lbs.	\$1.50	Soap powders	30-40 pkgs.	Rumford's	30 gal.	\$1.75 gal.	Rumford's	70 gal.	\$8.45 gal.	2 gal.	Lump soft Anthracite	24 T.	Ill.	\$5.50-11.50	Only at Loop partment stores				
Ford's Hill	none			Use vacuum cleaner	Rumford's	15 lbs.	\$1.50	Royal	6 lbs.	Rumford's	10 gal.	\$1.75 gal.	Rumford's	70 gal.	\$8.45 gal.	none	Mine Run	10 T.	Ill.	\$4.75	—				
Girls' Friendly Society Lodge	none			none	Rumford's	15 lbs.	\$1.50	Victor	10 lbs.	Rumford's	10 gal.	\$1.75 gal.	Rumford's	70 gal.	\$8.45 gal.	none	Small egg Cok	Franklin Co.	market price	87.50	On dry goods, hardware and staples				
Henry Borch House	none			Use sawdust and water	Rumford's	15 lbs.	\$1.50	Royal	6 lbs.	Rumford's	10 gal.	\$1.75 gal.	Rumford's	70 gal.	\$8.45 gal.	none	Mine Run	130 T.	Ind.	\$4.95	—				
Home for Aged and Disabled R. R. Men of America	none			none	Rumford's	150 lbs.	\$1.50 lbs.	Rumford's	15 lbs.	Rumford's	10 gal.	\$1.75 gal.	Rumford's	70 gal.	\$8.45 gal.	none	Screenings, Mine Run	12,000 T.	Lincoln, Ill.	\$3.25-2.75	Less than 50%				
II. Children's Home and Aid	none			none	Rumford's	150 lbs.	\$1.50 lbs.	Rumford's	15 lbs.	Rumford's	10 gal.	\$1.75 gal.	Rumford's	70 gal.	\$8.45 gal.	none	Heat from Hot House	—	—	—	60%				
Jewish Training School	none			none	Rumford's	150 lbs.	\$1.50 lbs.	Rumford's	15 lbs.	Rumford's	10 gal.	\$1.75 gal.	Rumford's	70 gal.	\$8.45 gal.	none	Soft egg	24 T.	Ill.	\$6.25	50%				
Lincoln State School and Colony	none			none	Rumford's	150 lbs.	\$1.50 lbs.	Rumford's	15 lbs.	Rumford's	10 gal.	\$1.75 gal.	Rumford's	70 gal.	\$8.45 gal.	none	Small egg Cok	24 T.	Ill.	\$6.25	Practically none				
Mary Crane Nurses	not used			Sawdust	Rumford's	20 bbl.	\$1.75 bbl.	Rumford's	12 lbs.	Rumford's	10 gal.	\$1.75 gal.	Rumford's	70 gal.	\$8.45 gal.	none	Mine Run	130 T.	Ind.	\$4.95	—				
Mary Davies Hotel	none			Sawdust	Rumford's	20 lbs.	\$1.75 lbs.	Rumford's	12 lbs.	Rumford's	10 gal.	\$1.75 gal.	Rumford's	70 gal.	\$8.45 gal.	none	Screenings, Mine Run	12,000 T.	Central Ill.	\$5.25	—				
Mercy Deaf-Deafness Orphanage	none			Thornward	Rumford's	15 lbs.	\$2.00	Rumford's	15 lbs.	Rumford's	10 gal.	\$1.75 gal.	Rumford's	70 gal.	\$8.45 gal.	none	Heat from Hot House	24 T.	Ill.	\$6.25	Nearly all				
Michael Reese Hospital	Prepared from soft soap	100 gal.	\$1.00 gal.	Sawdust	Rumford's	50 bbl.	\$5.00 bbl.	Rumford's	15 lbs.	Rumford's	10 gal.	\$1.75 gal.	Rumford's	70 gal.	\$8.45 gal.	none	Soft Egg	24 T.	Ill.	\$6.25	—				
North Ave. Day Nurses	none			none	Rumford's	15 lbs.	\$1.75 lbs.	Rumford's	15 lbs.	Rumford's	10 gal.	\$1.75 gal.	Rumford's	70 gal.	\$8.45 gal.	none	Small amounts	24 T.	Ill.	\$6.25	—				
Northwestern University Settlement	Antiseptol	15 gal.	\$1.15 gal.	Imperial Mfg. Co.	Rumford's	100 lbs.	\$2.15 lbs.	Rumford's	20 lbs.	Rumford's	10 gal.	\$1.75 gal.	Rumford's	70 gal.	\$8.45 gal.	none	Pocahontas Mine Run	130 T.	Franklin Co.	\$3.50-9.00	None—Generally Take 4 or 5 mos. credit.				
Oliver Institute	none			Sawdust and water	Rumford's	100 lbs.	\$2.15 lbs.	Rumford's	10 lbs.	Rumford's	10 gal.	\$1.75 gal.	Rumford's	70 gal.	\$8.45 gal.	none	Franklin Co. No. 2	130 T.	So. Ill.	\$6.14	—				
Providence Day Nursery	none			West Disinfecting Co.	Rumford's	100 lbs.	\$2.25	Rumford's	10 lbs.	Rumford's	10 gal.	\$1.75 gal.	Rumford's	70 gal.	\$8.45 gal.	none	Franklin Co. No. 2	130 T.	So. Ill.	\$6.14	—				
Rufus Davies Hotel	none			Sawdust	Rumford's	10 lbs.	\$1.75 lbs.	Rumford's	10 lbs.	Rumford's	10 gal.	\$1.75 gal.	Rumford's	70 gal.	\$8.45 gal.	none	Screenings, No. 2	12,000 T.	Pronto and Springfield	\$3.37	About 50%				
State of Illinois Dept. of Purchases and Supplies	none			Excelsior and others	Rumford's	24 lbs.	\$1.50 lbs.	Rumford's	10 lbs.	Rumford's	10 gal.	\$1.75 gal.	Rumford's	70 gal.	\$8.45 gal.	none	Screenings, No. 2	12,000 T.	Central Ill.	\$5.25	Very small				
St. Elizabeth Day Nurses	none			none	Rumford's	10 lbs.	\$1.75 lbs.	Rumford's	10 lbs.	Rumford's	10 gal.	\$1.75 gal.	Rumford's	70 gal.	\$8.45 gal.	none	Soft Egg	130 T.	Ill.	\$6.25	—				
United Charities of Chicago	100 gal.	\$1.00 gal.	none	none	Rumford's	10 lbs.	\$1.75 lbs.	Rumford's	10 lbs.	Rumford's	10 gal.	\$1.75 gal.	Rumford's	70 gal.	\$8.45 gal.	none	Twin City	100 gal.	82-25 gal. and others	—	—				
	Beau Brummel	1 gal.	\$2.75 gal.	none	Rumford's	10 lbs.	\$1.75 lbs.	Rumford's	10 lbs.	Rumford's	10 gal.	\$1.75 gal.	Rumford's	70 gal.	\$8.45 gal.	none	Small amounts	—	—	—	—				
				IXX Non Such	Rumford's	800 lbs.	\$1.50 gal.	Rumford's	70 lbs.	Rumford's	10 gal.	\$1.75 gal.	Rumford's	70 gal.	\$8.45 gal.	none	Pocahontas Mine Run	130 T.	Franklin Co.	\$3.50-9.00	Soap and disinfectant only				

Purchasing Data Summarized.—This blue print was submitted to the committee together with the following report:

In December, 1918, the possible savings to be effected through coordinating the purchases of the various social agencies was brought to your attention. The Central Council of Social Agencies then authorized the committee on centralized purchasing to collect data, and make specific recommendations. In accordance with that authorization, a questionnaire was sent out covering eight items of common use by the agencies. The result of this questionnaire may be summarized as follows:

The cost of liquid toilet soap varied from 8 cents a gallon to \$2.75 a gallon, the average price per gallon being \$1.39. Sweeping compound varied from \$1.50 to \$7.80 per cwt., average \$2.74. Baking powder ranged from 14 cents per pound to \$1 per pound, average 32 cents per pound. Disinfectants ranged from 65 cents per gallon to \$2.50, average \$1.55 per gallon. Other items were reported to be as follows:

	<i>Low</i>	<i>High</i>	<i>Average</i>
Boiler Compound	\$.03½ lb.	\$.12 lb.	\$.08 lb.
Milk	.24 gal.	.96 gal.	.41½ gal.
Varnish	1.10 gal.	3.25 gal.	2.20 gal.
Coal	Data insufficient for accurate comparison.		

The above data show fluctuations in unit cost of more than 3,000 percent. It may be that a good liquid toilet soap cannot be produced for 8 cents per gallon, but it should not cost \$2.75 per gallon. Somewhere in between these extremes a good soap should be secured. If an 8 cent soap is good enough for Charity A, Charity B can hardly justify the expenditure of \$2.75 for soap for the same purpose.

The cost of sweeping compounds did not vary so widely, but with sawdust selling at \$7.00 per ton, the price of \$7.00 per cwt. seems a bit high. Some of the items listed as disinfectants were sold for more than twenty times the cost of production. Boiler compound was used by comparatively few of the agencies, but showed a variation of more than 300 percent, in cost.

The most interesting facts were, however, brought out in connection with the purchase of milk. The summary of milk purchases shows the lowest cost per gallon to be 24 cents and the highest cost 96 cents. It is possible that the 96 cents price was paid for certified milk, and that it was delivered in small lots over a widely scattered district; but these facts are not shown on the reports, and I find that another institution doing apparently similar work, secured certified milk for 60 cents a gallon. In any case the difference in price paid was rather wide.

In this connection it is interesting to note that the "Chicago Tribune," of July 26, published a statement that Cook County was paying 32 cents per gallon for milk, and the city of Chicago paid 35 cents.

In making price comparisons it is of prime importance that we keep in mind the factors of quantity purchases, economical delivery units, and prompt payment of bills, any one of which may have a marked effect upon unit costs.

May I suggest to your committee that the price paid for milk, which is one of your largest items of expense, is in many cases apparently too high?

May I also suggest that because of present conditions in the distribution of milk, the milk dealers would, I believe, be most willing to make a special rate on milk for charitable institutions by joint action of the local organization of retail milk dealers?

If the facts were laid before them, I do not believe that the men who are responsible for the distribution of milk to the infants of the poor in this great city would take a purely commercial view of their part in the work. Once you have brought under control the cost of milk, it will be easy to attack other problems.

Again, Failure to Act.—Here again the committee was sold on the project, but there were no funds to employ the necessary clerical force to carry it through and again the voluntary committee did not feel that they could carry the burden indefinitely. The project was, therefore, permitted to sleep. Before the committee was finally relieved of its duties, however, the author was asked to prove his statement that there was not a hospital or other eleemosynary institution in Chicago belonging to the Central Council of Social Agencies that would not profit by a central purchasing bureau. The chairman of the general committee selected one of the largest and best managed institutions in Chicago, and asked the author to give some concrete illustrations of the way, or ways, in which that particular institution might profit through a central purchasing committee.

We investigated the purchase records of the institution selected for one month only, and found enough material to more than prove our contention that the mere bringing together of the purchases of any large group of units that had previously handled their purchases separately, would, of necessity, effect a considerable saving.

In this hospital we found that the majority of the meats used were purchased at a premium of more than five percent. over the market, and we also found that the laundry was using a washing compound sold under a fancy name, for which they had paid more than five times the market price.

Saving Through Coöperation Estimated.—May I repeat that the mere bringing together of the purchases of large numbers of units that have heretofore handled their purchases separately will result in a saving of not less than ten percent., and that this saving will more often be more nearly twenty-five percent. than ten percent. Before leaving this subject, let me cite three additional concrete illustrations.

In Milwaukee there are two firms, both of which use a large number of wagon wheels. Both firms were in the market at the same time, and the two purchasing agents pooled their orders, and effected a saving of fifteen percent. Re-

cently a large number of laundries have pooled their orders for equipment, and effected a very considerable saving.

For the past six months several large educational institutions have pooled their tax-free alcohol purchases and have materially reduced costs. In one instance the former cost was \$1.25 per gallon and the new pooled price 45c per gallon.

I feel certain that sooner or later all the various associations, such as those referred to above, will establish a central purchase bureau, where they may have many of their purchases pooled, and where they may receive authoritative advice concerning the merit and market price of certain commodities, a black and white list if you please.

This will remove much of the guess-work from the purchases of the members of these associations, and will effect savings which will total millions each year. It is much easier to save a dollar than it is to earn one, or to secure additional funds from the long-suffering public.

CHAPTER XXX

NOSTRUMS AND FANCY NAMES

High Prices for Wonder Goods.—The purchasing agent in every line of business each year is importuned to purchase standard materials under fancy trade names at vastly inflated prices. The buyer for the machine shop is urged to purchase the new and wonderful radium screw-cutting oil that costs twice as much as the oil he is now using, and is guaranteed so to reduce the cost of operating the machines that a huge net saving for his firm will result. The maintenance buyer for a string of buildings is urged to purchase a patented compound for cleaning out the drain pipes, or a wonderful new polish that costs four times as much as the polish he is now using, but which will effect a huge saving in time and labour costs.

The buyer for a baking firm is urged to purchase a new kind of baking powder that will not only cause the dough to increase in size, but will, in some mysterious manner, cause it to increase in weight. The buyer for a string of laundries is urged to buy a new kind of material that can be used in the place of soap, with a great saving in labour and no detriment to the clothes. This list could be extended almost indefinitely.

Beware of Fancy Names.—There are, I suppose, some of these items on the market which are based upon new and thoroughly sound principles, but I have never yet found one. Without exception a chemical analysis has shown that the so-called new and wonderful product was merely an old friend in new clothes, and credited with virtues which it did not possess. The difficulties of the purchasing agent are often complicated by the fact that he does not have ready access to a reliable commercial laboratory. All too often the salesman has already seen and convinced the man in charge of the operating department that the particular item he is trying to sell will really do all the wonderful things that he claims.

It is quite true also that under tests and demonstrations, these new and high priced products will often actually do the

work at a lower cost than the old reliable product you have been using.

This does not, however, prove that the new product is more efficient or that the old product is less efficient. It merely shows that the new product is, for the time being, used in a scientific manner, and that all too often in actual practice, the use of materials is far from efficient.

The Lubrication Expert.—In illustration of the above statement, let me cite a recent experiment in lubrication. A certain power plant had been using a certain brand of cylinder oil for a number of years, and had found it highly satisfactory. The salesman for another highly reputable oil company asked permission to carry on some tests with another oil that would cost somewhat more per gallon. The salesman was so sure his cylinder oil was much better than the oil that was being used, that the buyer finally arranged to have the lubrication engineer from this company study the problem. He studied the problem, delivered a long technical lecture upon the theory and practice of lubrication, and in a few days presented charts showing the old rate of consumption of the old oil, and the new rate of consumption of the new oil. There was undoubtedly a saving of over thirty percent.

How the Saving Was Made.—After the lubrication engineer had finished his report, and before the salesman had been given the contract, the purchasing agent went over the matter with the operating engineer. He found that the oil feeds had been so regulated that they were delivering only a little more than half as much oil as they had delivered before the lubrication engineer adjusted them. The interesting fact about all this is that the engines were amply lubricated even then, and that when the old oil was returned to the oil feed lines, and the regulators were still delivering about half the amount they had formerly, the engines were still adequately lubricated.

In other words, they had been wasting oil by feeding it into the cylinders too fast and the lubrication engineer had merely reduced the rate of feed, filled the oil tanks with his new high-priced oil with the fancy name, and taken credit for having a much more efficient oil.

This is a very good illustration of the sort of service that a salesman can perform for the purchasing agent. The point I wish to make here is, however, that the materials are very often credited with performing wonders when they are merely

old friends under new names, but applied more accurately and watched more carefully for the time being at least.

Disinfectants.—There are so many products, sold so extensively, and at such unreasonably high prices because the purchasing agent has neither the experience nor the means of detecting these near frauds, that a few more illustrations may not be out of place. If space would permit me to list all of these that have come to my attention during the last ten years, I am sure that the list would be long enough to include at least a few that every purchasing agent would recognize.

There are several disinfecting compounds on the market which are offered at prices varying from \$1.50 to \$3 per gallon. These are, almost without exception, excellent disinfectants. As a matter of fact, a good disinfectant can be made so cheaply that it does not pay to offer anything else. The actual cost of these disinfectants ranges from \$1.50 to \$5 per barrel.

There is no reason why these products should be purchased at the fancy prices when you can make the most efficient disinfecting spray by dissolving one pound of bleaching powder in one gallon of cold water. This material must, however, be made up just before it is used. If you want the disinfectant that is often offered to you at fancy prices, use dilute formaline.

Soap Pastes and Jellies.—Because a very small amount of either sal soda or soda ash will cause a gallon of water to solidify into a jelly-like soapy substance, there are many soap pastes and soap jellies that have very little commercial value. Many of these items that are offered as high-grade soap products are really made up of more than 90 percent. water, a little soap and soda ash, and a little fine sand. Soda ash in various forms is offered to the trade daily under fancy names at prices ranging from three to ten times its actual value. One of the most attractive forms is in white, rice-like grains. This is sometimes offered as a by-product of the manufacture of linseed oil.

SOME ANALYSES OF SAMPLES OF SOAP

		<i>Analysis Shows Percentages</i>
<i>Soap Pastes:</i>		
(1) White jelly soap. Sold as substitute for green oil soap.	92.7	water
(2) White paste soap	95.5	water
	1.5	sand
	3.0	soap
(3) Automobile paste soap	78.7	moisture
(4) Janitors' soap paste	84.6	moisture
<i>Soap Substitutes:</i>		
(5) This was guaranteed to do any work that soap would do and not injure either hands or clothes.	69.70	sodium carbonate
	13.13	moisture
	2.60	sodium hydrate
	4.79	sodium chloride
	2.67	sodium sulphate
	7.11	calcium & mag- nesium oxide ext.
	100.00	
(6) This product was sold as a substi- tute for soap and was supposedly a by-product of the manufacture of linseed oil. This was marketed at 15 cents per lb. The actual value was less than 3 cents.		Crystalline sodium carbonate containing ten molecules of water.

CHAPTER XXXI

PRACTICAL PROBLEMS FOR SOLUTION

Incidents of the Day's Work.—Experience shows the value of practical problems which may be torn to pieces and analyzed at leisure. Without exception, the following problems have been lifted bodily out of the day's work of some member of the National Association of Purchasing Agents. Only enough of the unimportant details have been changed to prevent any possible embarrassment to the men concerned. Most of the incidents referred to occurred in Chicago. Perhaps you will recognize some as old friends. Because many of these problems are the type that no two purchasing agents would solve in the same way, no solutions have been offered.

Hauling Cinders.—The unions had succeeded in getting wages fixed at a high rate, and in order to protect themselves the Team Owners' Association had fixed the price for all hauling. One of the duties of the purchasing agent for a large manufacturing company was to dispose of the cinders. They had to be loaded and hauled by trucks and teams. The rate fixed for this service was \$1.35 per yard. When the next coal contract was made a clause was added specifying that the coal dealer remove the cinders at \$.90 per yard.

During the life of this contract the contractor repeatedly complained about the amount of money he was losing on the cinder contract. After the contract expired, and before the new contract was negotiated, the contractor continued to remove cinders without any discussion of the price. He submitted his bill on the basis of \$.90 per yard.

Where the Contractor Misleads.—The same day the bill was submitted, he inadvertently admitted that he had been making a profit of 25c per yard on all the cinders moved during the year. In view of these facts, what settlement would you make with the contractor? You have enjoyed a fairly low price during the life of the contract. The contractor has misled you concerning the profit he had been making on the contract, and his relationship with you was one where you could

rightfully expect honesty and faithful performance. He has hauled cinders beyond the life of his contract without authorization.

You are employed to see that your firm secures the largest possible ultimate value for every dollar spent. What would you do? What method would you pursue? Why?

Paper Towels.—The market price of a given grade of paper towels before the war was \$6 per case. During the war the price rose to \$16.50. Late in 1920 the market began to weaken, and the price fell to \$10 and then stiffened. Just at that time the representative of a reliable mill came to your office with an offer of \$9 per case, with the rather unusual stipulation that if the price should fall farther before you had consumed all the towels, he would give you credit for the difference. He was crowded for room and offered to shave the price to \$8.90 if you would take one hundred cases.

You accepted this offer, and the market stiffened a bit. But before you had used more than half the shipment, competitors were offering similar goods for \$7 per case. The particular mill that sold you, and two or three other mills, did not, however, follow the market down, and technically the market for the towel you bought had not changed.

What are your duties and your rights? How would you proceed?

Tote Boxes.—The buyer for an automobile plant uses a good many heavy tote boxes. The pre-war price was \$12. He was in the market for two hundred, and the written quotations received from reliable dealers were all around \$20 each, with the single exception of one manufacturer who quoted \$11.75. This particular plant was very hard hit by the business depression, and needed this job rather badly. The purchasing agent called the salesman in, and told him that he would like to give him this order, because he had served him so well in the past, but that most of the bids on the job ran about the same figure. If, however, the salesman could see his way clear to cut his price to \$11.25, he would feel justified in giving him the order.

The salesman cut the price, got the order, and delivered the goods promptly. No doubt he made a small margin of profit even at that figure.

Was the purchasing agent justified in making the state-

ments he did to the salesman? Was this line of attack strictly in accordance with good ethics? What is the definition of a lie? Did the purchasing agent lie? Is a lie ever justified? When?

The Better-Price Salesman.—Sooner or later every purchasing agent comes in contact with the salesman who offers to quote a little better price than his competitors, if the buyer will only tell him what that price is. From asking for that information directly, or trying to get it by indirection, is only a step to requesting that he be shown the other man's quotation.

Even the most inexperienced purchasing agent will not fall for tactics of that sort more than once, but it is rather surprising how much of that sort of thing is done. In small cities the direct ill results of this practice are not felt so severely as in the larger cities, but sooner or later the result is the same. The purchasing agent either learns not to be led astray by these tactics, or he is replaced.

Wholly aside from the ethical problem involved, the quiet circulation of the word that Buyer X will let the other fellow know the prices quoted him gets abroad, and the various jobbers' associations take steps to discipline the men who have been cutting prices.

What would you do if a salesman in whom you had great confidence were to ask you what one of his competitors had quoted on a given bill of goods? Would you stand upon your dignity and show him out of the office? Would you pretend that you did not understand? Would you look him in the eye and ask him if he thinks that is the basis on which you do business? What reply would you make?

The Carbon Paper and the Gold Fountain Pen.—In the winter of 1920 many members of the Purchasing Agents' Association received letters from an Eastern firm offering to send them a gold-plated fountain pen with the first order of carbon paper. This, they explained, was simply their method of giving the buyer the benefit of the saving they effected by having no salesmen.

If, after they had tried the carbon paper, they did not think theirs was the best carbon paper on the market for the price, the buyers could return the portion of the paper that was unused, and keep the fountain pen for their trouble.

What reply would you make to that sort of offer? If the

paper were really a good value, is there any reason why you should not avail yourself of this opportunity to secure a gold-plated fountain pen without cost? If you had been buying that brand of carbon paper for several weeks or months, and found it quite satisfactory, what action would you take if the jobber were to send you a gold-plated fountain pen with his compliments? Would it make any difference if he were to send you this pen at Christmas? If he were to send the pen to your home instead of to the office? Who pays for the pen in the long run?

Cigars.—Many purchasing agents receive enough cigars at Christmas time to keep themselves and their friends well supplied for six or eight months. Is that right? Who pays for those cigars? Does it make any difference what your personal relations may or may not have been with the firms that send the cigars? If it is right to accept cigars, why is it not right to accept silk umbrellas? If it is right to accept \$50 worth of cigars from a man with whom you have done a lot of business, why is it not right to accept a suit of clothes from the same man, under similar circumstances? Does it make any difference whether you have placed a lot of business with him, or are merely planning to place business with him?

Miscellaneous Christmas Gifts.—A member of the purchasing Agents' Association of Chicago said recently that he accepted all the gifts that were offered at Christmas, and then went over the list of gifts with the general manager of his firm, and decided just what disposition to make of each gift. As a result of this conference some gifts were returned, some were kept by the purchasing agent, and some were kept by the general manager.

What do you think of that sort of policy? If you do not think this is right, what are the reasons for your decision? What is your policy?

The Purchasing Agent with the Better Price.—A purchasing agent of my acquaintance informed me that he had a good deal of success in reducing printing costs by telling every bidder that he had a bid from a competitor that was materially lower than his bid. On a recent purchase the lowest bid was \$200, but he told one of the bidders that he had a quotation of \$160, but that he could have the job if he would change his bid to \$150.

What is wrong with this method of procedure, aside from

the ethical point involved? What will be the probable result if that practice is continued? In what way, if any, does this problem differ from the problem concerning the tote boxes?

Waste Paper.—The purchasing agent had sold most of his waste paper to an old man for the past twenty years. When No. 1 mixed paper was worth 45c per hundred, he made a verbal agreement that he would sell all the waste paper offered at that price for six months. The old man then made a contract to sell that paper to one of the box board mills for sixty cents per hundred. After the agreement had been in effect for three months, the box board mill burned down and the firm went into the hands of a receiver. In the meantime the market price had fallen to twenty-five cents per hundred, and the old man offered to take the paper for the rest of the period at twenty-five cents.

What would you do? Let us assume that you finally agree to modify the price, and the market again drops, to fifteen cents per hundred, and the old man again wants to pay you only the market price. If the conditions had been reversed and the market had been steadily advancing, would you have taken advantage of the incapacity of the mill, to force a higher price from the paper collector?

Paint Tests.—Let us assume that your firm uses a large quantity of paint and varnish. Your engineering department has made numerous tests and your line is pretty well standardized. You are constantly bombarded with requests by other firms to run a test on their paint or varnish. Because of the time and expense involved you can hardly afford to test every paint and varnish that is offered. If, however, you refuse to test out any of the new products you may miss something really worth while.

Let us assume that your firm is just completing a set of samples, and you arrange for the varnish firms each to supply free of charge enough of their product to finish one sample.

Is there anything wrong in that? If each sample were a room, would it be all right to have each salesman furnish enough material to finish one room? Let us assume that you are in charge of these tests, and are personally interested in them. Let us also assume that you have just built a home, and are about ready for the paint and varnish.

Do you think that it would be right to ask the salesman for

each varnish house to furnish enough material to finish one room? If the salesmen were to request that sort of a test, would you accept?

Would you be subject to criticism if you did accept, or if you refused? This is a very nice question, and much of the success or failure of many purchasing agents depends upon the way in which they have satisfactorily solved problems of this sort.

The Coal Contract.—In the early spring of 1921 the coal operators in the southern Illinois district succeeded in holding the price of all coal rather steady. The nominal price of screenings was \$2.85 per ton, f.o.b. mines.

In the latter part of May a Chicago purchasing agent was offered a contract for Franklin County screenings at \$2.25, which was then a little below the contract market. The lines of authority in that particular firm were such that coal contracts were signed by the chairman of the board of directors, after the board had formally authorized it. The purchasing agent merely recommended the contract to the board, but was always careful to see that only such contracts were recommended as would be approved. After going over all the factors in the matter, the purchasing agent told the coal dealer that he would recommend his contract. He submitted his formal recommendations, but the action of the board was delayed for ten days, and in the meantime the contract market had fallen fifty cents per ton.

What are the duties and obligations of the purchasing agent under these circumstances? He has technically carried out his agreement by recommending the contract to the board of directors. As he is employed to secure the best possible values for his firm, is he justified in withdrawing or modifying his recommendations? If he does not withdraw his recommendations should he report the farther fall in the market to his board? If the market had advanced instead of declining, what would have been the rights and obligations of the vendor?

Assuming that the net difference of fifty cents per ton meant a saving of \$20,000 per year to his firm, would the amount involved alter the decision that he should reach? Would the fact that even the higher price meant that the coal operator was doing business at a loss have any effect upon your ultimate decision?

The Glycerine Purchase.—In the Spring of 1920 the representative of one of the large brokerage houses with which the purchasing agent had done no business called, and offered glycerine at six cents below the market. The buyer gave him an order for a ton to be delivered inside of two weeks. When ten days had elapsed, he asked for delivery and received no answer. During the next thirty days numerous requests for delivery were made but the broker did not reply to any of them and did not fill the order. As the material was urgently needed by that time, the buyer got the broker by long distance and demanded the goods. The broker informed him that the salesman had made an error in his quotation, and that he could not fill the order at the price quoted.

The purchasing agent told the broker that he would either have the goods inside of one week, or he would report the transaction to the secretary of the National Association of Purchasing Agents. The broker filled the order and billed it at the price quoted. Did the purchasing agent act within his rights? How would you have handled this transaction?

Duplicate Shipments.—During the period of mounting prices which followed the armistice after the World War, there was a considerable disarrangement of the office forces in many lines. This was due to the large turnover of the help.

The purchasing agent for an automobile concern had been trying for weeks to secure delivery of a lot of steel that had been bought before the recent advances in price. Finally he not only received the shipment he had been asking for, but received also a duplicate shipment. He called the shipper's attention to the duplicate shipment, and offered to keep it at the same price. The shipper tried to collect on the basis of the market for the duplicate shipment.

What are the rights and obligations of each? If the shipper had duplicated the shipment on a falling market, what action should the purchasing agent take? Give the reasons for your decision in this case.

Envelopes.—In the spring of 1921 the purchasing agent for one of the railroads received a requisition for the following envelopes, size $6\frac{1}{2} \times 9\frac{1}{2}$ printed: 100 M with a corner card, 50 M with a slightly different corner card, and 15 M with another minor change. The stock was to be the same and the only change was in the last line of the corner card. The small lot of envelopes was needed for a special circular

which was to be mailed in three weeks. In response to requests for quotations, the buyer received bids from four reliable firms which ranged from three dollars and seventy-five cents to four dollars and fifty cents. Just as he was about to place the order, the representative for a firm with whom he had had no dealings called and offered to supply a slightly better stock for three dollars and five cents per thousand. When the question of deliveries came up the salesman assured him that he could have the finished job in less than two weeks. Because of the fact that the mailing job was not an ordinary bit of routine, the purchasing agent was obliged to get a special authorization from the general manager to whom he reported the price.

The new firm was given the order. After the order had been placed four days, the new salesman reported that he had made an error in quoting and that the price should have been three dollars and thirty cents because of the two changes in the corner card. The purchasing agent explained that that particular job was covered by a special appropriation and that he would find it embarrassing to request additional funds for that job at that late date and asked him to put it up to his firm to protect him. This the salesman promised to do. At the same time he renewed his promises of speedy delivery. The second day after that the salesman again put in his appearance with the request that he be permitted to bill the envelopes at the increased price. The purchasing agent told him that so much time had already been lost in the transaction that he seriously doubted his ability to keep his delivery promise and that he must either deliver at the original price quoted and deliver on time or accept cancellation. The salesman then agreed to follow up the transaction personally and to see that the job was delivered in time and billed at the price originally quoted.

The envelopes were not delivered in two weeks, and several very definite promises were passed over, with no excuse from the salesman. It was finally necessary to purchase ten thousand envelopes from a local firm at a cost of \$5 per thousand, in order to get the circulars out in time. When the original order for envelopes was delivered, they were billed not at \$3.05 but at \$3.30.

Under these circumstances what would you do? What deduction, if any should be made from the bill covering the orig-

inal lot of envelopes? Would the fact that any deductions made were charged to the drawing account of the salesman have any bearing upon your decision? What are your rights, both legal and moral?

The Steam Pump.—Let us assume that your firm is about to build a new power plant, and that before the plans were quite ready, you found it necessary to install a new feed water pump in the old plant. After due consideration you decide to purchase a pump from the X Steam Pump Co., and to have the pump so planned that you can use it in the new plant when it is erected. The pump is delivered, inspected, installed, and paid for. After being in service for three weeks, the water end develops a leak, and your engineer finds a blow hole in the casting. You report the matter to the X Pump Co., and they say they will gladly replace the defective part at any time you request it. They point out, however, that the change in the water end will necessitate the shut down of that part of the plant for nearly a week, that the new plant will be ready to receive the pump in two years, and that the pump will cause no further trouble where it is, as long as the water pressure is not increased.

The salesman asks permission to defer the installation of the new water end until the pump is transferred to the new power house two years later. He acknowledges his obligation, and that of his firm to replace the defective part, but asks to be relieved of the apparently unnecessary expense at that time.

If the firm is perfectly reliable what action will you take? You might of course have the new part shipped, and hold it until you are ready to install it, but this is a very heavy casting, and will be very much in the way for two years. In addition to that, something may happen to it while you have it in storage, and you will then have no recourse.

The Scrap Iron Contract.—The buyer for the X Foundry Co. entered into a contract to purchase forty cars of scrap iron of certain specifications at the rate of five per week for eight weeks. This contract was placed at the market price. Part of the material shipped on this order had not been quite up to specifications, but because of the great shortage of scrap, the slight variations from specifications were overlooked.

The market broke sharply, and the purchasing agent re-

fused two cars of scrap because they were not up to specifications. The vendor offered to replace these two cars with iron that was up to grade, but the purchasing agent took the position that since the vendor had had every opportunity to ship scrap iron of the grade specified, and that since the material shipped was not up to specifications, he was under no obligations to accept a replacement shipment. In the meantime, while the matter was being argued, the price of scrap iron had dropped to less than half the former price. Under these circumstances was the purchasing agent within his rights in refusing the replacement shipment?

If the vendor sues, can he force him to take the replacement shipment or can he collect damages? What effect, if any, would it have if the vendor had or had not contracted for the scrap iron, or if he was following the market and would profit greatly by replacing the shipment at the contract price?

Cotton Yarn.—In the spring of 1920 there was a great shortage of materials of all kinds, and many manufacturers found it necessary to pro-rate their product among their various customers. A textile manufacturer had purchased most of their cotton yarn from one firm ever since they had started in business. At the beginning of each quarter of the past year and a half the vendor had told them how much cotton yarn they could spare them. Their allotment had been about 20,000 pounds per quarter. In the spring of 1920 the vendor announced a stiff advance in price, and told the textile mill that they had found it possible to increase their allotment to 50,000 pounds for the next quarter. If they wanted that amount, they must notify them in five days. After consulting the directors of the firm, the textile manufacturer decided to accept the whole allotment. The quarter had barely begun when the price of cotton yarns of all kinds broke sharply.

Raw cotton of the grade used dropped 75c per pound, and the finished yarn dropped from \$4.50 per pound to \$2.50 per pound. The vendor of cotton yarn refused to take a reduction in price, and refused to cancel the remainder of yarn still on order.

What action would you take if you were the purchasing agent for that firm, and the contract had been made by you, after consultation with the members of the firm?

The Supply List.—The purchasing agent for one of the Chicago department stores sent out a ten-page inquiry to

manufacturers of cartons. The items on the list were not special, and could have been picked up from any one of several local jobbers. Because of a trade agreement which one of the manufacturers had with the dealers, the Chicago representative informed the jobber that the factory was bidding on that list direct, and that he knew that his competitors were bidding direct. The jobber then called the buyer for the department store and asked permission to bid on the list.

What action should the buyer take on that request? It is quite possible that the jobber has on hand stock that he wants to get rid of, and that he may be in a position to underbid the manufacturer on some items. Is it advisable to submit requests for quotations to both manufacturers and jobbers at the same time? Why?

The Automobile Tire Purchase.—The purchasing agent for one of the smaller automobile manufacturers in Detroit was limited to the purchase of one make of automobile tire for the larger part of his requirements. The manufacturer of the tires had adopted the policy of protecting the jobber. He would sell the automobile manufacturer direct, but at the same price that the jobbers charged. His line was handled by several jobbers in town. As buying from the tire manufacturer meant delays and added freight charges, and resulted in no saving, the purchasing agent bought most of his tires from one or more of the local jobbers. In order to cut expenses, the purchasing agent proposed to one of the local jobbers that he give him all the business, in return for a rebate in the form of a credit memorandum at the end of each quarter.

The representative for one of the other jobbers noticed that they were not getting any more tire orders from this tire manufacturer, and tried to find out what was the cause for this change. They finally managed to find out through one of the clerks in the purchasing department that each quarter the other tire jobber sent to the purchasing agent a credit memorandum, with no explanation as to the reason for its being issued. The jobber reported this matter to the tire manufacturer, and the rebating jobber lost his agency. The jobber who had reported the matter to the tire manufacturer then tried to secure the bulk of his tire business again.

What action should the purchasing agent take? If there had originally been only two jobbers in town and one of them was now eliminated, should the purchasing agent let the job-

ber profit by his action in reporting the rebate to the manufacturer? If it is going to be very inconvenient to purchase these tires out of town from other jobbers, is he warranted in putting his organization to that additional trouble and expense.

The Motor Car.—In the spring of 1921 the X Motor Car agencies in the larger cities, acting under instructions from the home office, established separate clearing houses to handle all old cars that were turned in. All appraisals were made by the representative of this central clearing house, and his appraisals were final. The purchasing agent for one of the larger hospitals in Chicago decided to turn in a coupe for a new one, and secured an appropriation of \$300 for the transaction. When the estimator for the clearing house looked over the old car, he told the purchasing agent that it would cost him \$375 to make the trade. The purchasing agent was confident that the old car could be sold for at least \$75 more than the agency would allow. He therefore put it up to the salesman for the X agency to find for him a buyer for the old car at a price that was \$75 more than the price the agency would allow. The salesman did this, and the old car was sold for cash, but the salesman lost his job, because it was contrary to the rules of the X business in Chicago to help a customer sell his old car for more than the clearing house would allow him. Moreover, it was contrary to the regulations for a new-car salesman to deal in old cars.

What action should the purchasing agent take in this matter? Why?

Rubber Stoppers.—The buyer for a large institution bought a good many rubber stoppers of certain specifications. These had been purchased from one of two or three manufacturers. It was, however, necessary to occasionally pick up small lots from a jobber in order to keep up the assortment. The price at this time was about 80c per pound from the manufacturer, and the jobbers charged \$1 to \$1.25 for the small lots picked up. Two new factories are opened up, and the purchasing agent sends both of them copies of his next inquiry list. Since the last purchase, the cost of all the materials entering into the manufacture of the stoppers has greatly declined. The purchasing agent expects to buy the next lot of stoppers for about 70c per pound. When the quotations are received, he finds that the manufacturers he has been deal-

ing with quote the same prices as before—80c per pound. One of the new manufacturers quotes 85c, and the other quotes 65c. The second day after the quotations are in, and just after the order has gone to the manufacturer who has quoted 65c, the sales manager withdraws his price and quotes 80c per pound. The purchasing agent telephones the sales manager and by carefully wording his questions, learns that the change in price has been made because one of the jobbers that had occasionally served the institution's needs for small fill-in orders at a high price had accidentally learned of the 65c quotation, and had complained.

What action should the purchasing agent take in this matter?

The Overshipments of Coal.—In the summer of 1921 soft coal screenings were a drug on the market. The purchasing agent for a large industrial plant purchased one hundred tons of screenings at \$4.75 and three hundred tons at \$4.50 from the same firm. This price was for waggon deliveries. Because the market was soft, he specified that on neither order should the quantity vary more than five percent. It so happened that the vendor was delivering other coal on contract, and the purchasing agent had not the facilities for the continuous and immediate check of the amounts of coal delivered. When the bills came in, he found that the order for three hundred tons had been overshipped just five percent., and the order for one hundred tons had been overshipped over forty per cent. At about that time the purchasing agent had purchased one car of screenings from the same district for \$4.27 per ton delivered. He therefore refused to pay the vendor more than \$4.27 per ton for the forty tons overshipped.

Is the buyer justified in this stand? What would you have done? And why? Would the previous service rendered by that firm have any bearing on your decision? If the firm really wants to do the fair and right thing, will they be apt to object to this settlement?

The Salesman Who Lied.—The salesman for a hardware jobber with whom the purchasing agent had never done any business made a very low quotation on files. The purchasing agent gave him an order for a hundred dozen. Three days later the salesman called, and said that he had made a mistake in the quotation, and asked permission to increase the price. His new price was just a bit higher than the next lowest bid-

der. The purchasing agent told him that he would not feel justified in giving him the business at that figure, and that he could consider the order cancelled if he did not want to fill the order at the price first quoted. The salesman then agreed to fill the order at the first price, and to see that there was no further delay. When the shipment was due, the salesman promised to have it there three days later. When the three days was up, the salesman again appeared with promises, but no files. The firm had shipped the wrong stock number, he said, and the shipment had been returned. Because the shipment was so long in coming, the buyer had to pick up several dozen files at a much higher price, and the salesman agreed to pay the extra cost.

Quality Right, Billing Wrong.—When the order was finally delivered, the files were of excellent quality, but they were billed, not at the price quoted, but at the higher price. Through a clerical error the bill was paid, and the purchasing agent wrote the firm for a credit memorandum for the amount of the overcharge, plus the amount of the extra cost on the files picked up. The president of the firm refused to back up the promises of the salesman, and refused to settle the claim. The purchasing agent threatened to report the transaction to the secretary of the National Association of Purchasing Agents if the claim was not settled at once. The salesman then came out, and said that if the purchasing agent pressed the claim, he would not only have to pay it himself, but that he would probably lose his position.

Under these circumstances, is the purchasing agent justified in pressing the claim? Is he justified in failing to press the claim when his own firm is entitled to the refund? What would you have done under these circumstances? Why?

The Machinery Purchase.—The purchasing agent for one of the large hotel supply houses of Chicago sent out a request for quotations on a small mortising machine of a certain kind. This machine was distributed through jobbers, and the resale price was controlled by the manufacturer. The resale price was \$90. One firm quoted \$48, the order was placed on that basis, and the vendor acknowledged the receipt of the order quoting the price. When the machine was received, the purchasing agent found that the vendor had shipped a machine of inferior quality, manufactured under a different name. The purchasing agent asked the salesman to pick up

that machine, and ship the machine ordered. The salesman said he thought he had shipped the machine the buyer wanted, and the other machine could not be furnished at the \$48 price.

The purchasing agent showed from his files that the order called for the more expensive machine, and that the formal acknowledgment of the order specified the more expensive machine. The salesman then flatly refused either to ship the more expensive machine, or to accept for credit the inferior machine.

What action should the purchasing agent take in a case of this kind? Is he justified in insisting upon the shipment of the \$90 machine at the \$48 price? Would the attitude of the salesman have anything to do with the decision that you would reach? Does the personal attitude of the salesman toward the purchasing agent alter the facts, or have they any real bearing upon the rights of the purchasing agent or the justice of the claim of either party?

The Paint Salesman.—The salesman representing a well established firm in the Middle West had been trying for several years to get the buyer for a State institution to use his particular brand of white enamel. For some reason he never could get very far with that particular purchasing agent. Finally, he came to him with the following proposition: "I know that my white enamel is the best enamel on the market at any price, and I know that it will stand any test that the enamel you are now using will stand, and I know that it will cost less per gallon, and will cover 25 percent. more surface.

"I am so certain of this that I am willing to go to almost any length to demonstrate the facts, and will spend any amount within reason to prove to you that my claims are true. I am willing to ship as many barrels of this material as you care to order, with the understanding that you put this enamel to any test you like in any way you like. If it does not do all I claim that it will do, we will make you a present of all the enamel in the shipment, and no bill will be sent you until you ask us to send it to you."

The purchasing agent said that he would accept this offer, if the salesman would put that proposition in writing, and if he would specifically state his claim that his enamel would cover 25 percent. more surface than the enamel that he was then using. The document was drawn up, the purchasing agent had the head painter conduct the tests, and the report was

that the old enamel covered nearly as much surface as the new enamel. The purchasing agent had ordered enough enamel to last nearly a year, and refused to pay for it. In addition to that, he turned over to the representative of the firm that had been supplying him enamel, the signed statement of the salesman for the new company, and the old company sued the new company for libel. What do you think about the ethics of this sort of transaction?

Soap.—One of the large soap manufacturing plants in Chicago had a trade agreement with the Chicago jobbers not to sell to any Chicago firm direct. All inquiries for soap coming from any Chicago customer were to be referred to one of the Chicago jobbers. This manufacturer did, however, sell soap direct to out-of-town dealers. The purchasing agent for a plant in Chicago with out-of-town branches, discovered that he could buy this soap and have it shipped to Duluth for less than he could have it delivered in Chicago. It so happened that this firm operated a fleet of boats between Duluth and Chicago. The purchasing agent, therefore, had all soap for Chicago marked for shipment to Duluth, and delivered to the docks. He then had the city waggon pick up these shipments, and deliver them to the Chicago factory. In this way he saved the commission of the Chicago jobbers and materially reduced the cost of the soap at the Chicago plant.

Is this ethical? What would you do if you were a Chicago jobber and inadvertently found out what was going on? Would you be justified in threatening to drop the line of the manufacturer if he did not discontinue this practice? What right has the jobber to take toll from the Chicago manufacturer when he can secure his soap direct from the factory more quickly, and at less expense without his intervention?

The Plumbing Supplies.—Certain manufacturers of plumbing goods had a trade agreement with the plumbers that they would give the plumbers 25 percent. discount, and any goods that were sold direct to the consumer would be sold at list price. The plumbers had things arranged so that all the materials they sold for the manufacturers must be installed by them, and that none but union men could handle the job from start to finish. The purchasing agent for one of the large manufacturers in the Middle West made an arrangement with one of the manufacturers of plumbing materials whereby he got a discount of 20 percent. and the material

was all billed by the manufacturer in the name of a local plumber, who merely lent his name to the transaction, in return for the extra 5 percent. commission.

Is this ethical? Is this the sort of arrangement that you would sanction, if you were the president of the firm employing the purchasing agent who made this arrangement?

The Defective Casting.—The purchasing agent for a New York manufacturer ordered a cast steel ring for the idlers on the outside of a paint mixer, at a cost of \$150. Of this, \$120 was for the casting, and \$30 for machine work to be done outside, and included in the bill from the foundry. The order specifically stated that this must be a steel casting, and gave the finished size. In shipping the pattern, however, the shipping clerk shipped a pattern designed for a gray iron casting. As a steel casting shrinks nearly twice as much as a gray iron casting, the finished ring was too small, and had to be discarded. If the shipping clerk had sent the right pattern, the finished casting would have been accepted. If the foundry had carefully checked the dimensions of the pattern with the specifications on the order, the error would have been detected before the casting was made.

As soon as the purchasing agent learned of the difficulty, he examined the casting carefully, and found two or three blow-holes. These blow-holes were not large enough to have caused the rejection of the casting under other circumstances, but served as an excuse for the rejection. The casting was rejected and the order cancelled. A new soft gray iron casting was ordered from another foundry, because they could not wait for another steel casting. The foundry fought the claim, but finally allowed the invoice to be cancelled.

How would you have handled this adjustment? Why not lay all the cards on the table and assume at least part of the cost of the spoiled casting?

INDEX

A

Accounts payable, record, 20, 71
Advertising, 156
Alloys, 171, 218
American decimal standard, 127
Analysis, coal, 191, 194
Ash, fusing point, 187
Association of American Colleges, 262
Automobile tires, 145, 287

B

Bank letters, 6
Better-price salesman, 279
Bibliography,
 budget, 98
 coal, 192
 lubrication, 4
 lumber, 114
 paper, 138
 steel, 219
Bids, confidential, 40
Billboards, 163
Blast furnace, 213
Brands, paper, 128
Brass, 165
Business cycles, 12
Budget, 94
Buyers, fussy, 27
 grouchy, 26
Buying by specification, 75
Buying, advertising, 156
 coal, 183
 machinery, 174
 steel, 207
By-products, 246

C

Campaign, preparation of, 159
Canvass, 162
Carbon, 217
Carbon papers, 87, 279
Cash discount, 23
Catalogues, 63-65
Central Council of Social Agencies,
 269
Chairs, 89
Chemical tests, 135
Chicago Elevated, 225
Chief clerk, value of, 29

Christmas gifts, 280
Cigars, 280
Cinders, hauling, 277
Classification of scrap, 253
Coal, 183
 analysis, 194
 bibliography, 192
 contracts, 282
 deterioration, 204
 pile fires, 203
 storing, 200
Commonwealth Edison Company's
 system, 51
Confidential bids, 40
Contracts for scrap, 249
Control of stock purchases, 100
Co-operation, 68
Co-operative buying, 262
Co-ordinated purchase machine, 31
Copper, 165
Costs, 89, 170
Cotton yarn, 286
Coupon, 161
Creamery supplies, 139
Credits, relation to, 67
Current literature, how to find, 5
Customs, paper trade, 136

D

Decay, in wood, 113
Deckle edge, 122
Defective castings, 293
Department, production, relation to, 66
Desks, 88
Detail, importance of, 30
Deterioration of coal, 204
Director of purchases, 72
Disinfectants, 275
Duplicate shipments, 283

E

Education, 33
Electric steel, 216
Enthusiasm, capitalized, 32
Envelopes, 283
Equipment of paper buyer, 117
Ethics, 37
Even temper, essential, 34

F

Family worries, 31
 Files, 23
 Fires, coal pile, 203
 Fluxes, 210
 Follow up, 22
 Forms, 49, 51, 52-62, 90, 105-110
 must fit the job, 42
 Foundry supplies, 222
 Freight rates, 185
 Friendliness, 34
 Fuel, for steel, 209
 Function of specifications, 74

G

Gambling, in commodities, 11
 Gifts, 21
 "Goodfellow," the, 28
 Graft, 21
 Guesswork, eliminated, 96

H

Heat, conductivity, 152

I

Information, sources of, 4, 5, 6
 Inside information, 39
 Inspections, 79
 Integrity, 33
 Inventory, control, 100
 perpetual, 18

L

Laboratory tests, 151
 Library, how to use, 3
 Lubrication, bibliography, 4
 Lumber, 111
 bibliography, 114

M

Machinery, mine, 174
 purchase of, 290
 Money, losing, 155
 Motor car, the, 288
 Moulding sands, 222

N

Nostrums, 273

O

Office equipment, 86
 Office supplies, 42
 Order index, 48
 Overbuying, 96
 Overshipment, 289

P

Paper, 116
 bibliography, 138
 testing, 132
 towels, 278
 Paint, testing, 76, 281
 Pens and inks, 87
 Perpetual inventories, 18
 Personnel, 66
 Physical equipment, importance of, 82
 Pig iron, 210
 Plumbing supplies, 292
 Preparing campaign, 159
 Prices, theory of, 9
 Printing, purchase of, 90
 Problems, 277
 Production department, relation to, 66
 Production, paper, 116
 Pulp, 118, 119
 Purchase schedule, 18

Q

Qualifications for success, 33
 Quality right, billing wrong, 290
 Quotation, forms, 42

R

Reasons for a purchase, 25
 Receiving, 228
 Reciprocity, advantages of, 72
 Reclaiming lumber, 248
 Recommendations, 92
 Record, accounts payable, 20
 Relation to, credits, 67
 factory superintendent, 67
 sales, 72
 Responsibility, 69
 Return goods notice, 238
 Routine, at University of Chicago, 98
 Rubber, 146
 stoppers, 288

S

Sales, relation to, 72
 Salvage, 244
 Sampling, coal, 188
 Scale, steel, 216
 Scrap iron contracts, 285
 Scrap material, 231
 Shoddy, 152
 Sizes, paper, 126-127

Soap, 292
Space, advertising, buying, 157
Specifications, buying by, 75
 drafting of, 74
 function of, 74
lumber, 112
 mine machinery, 177
Standardization, 91
Standardizing forms, 143
Steam coal buying, 183
Steam pump, 285
Steel, bibliography, 219
 buying, 207
 prices of, 9
Stock balance, 84
Storage, coal, 184
Storekeeper's order, 227
Stores, 81
Stores and purchasing, 70
Storing coal, 200
Structural changes in steel, 217
Success, measure of, 36
Superintendent, relation to, 67
Swift & Company's system, 43
System, Commonwealth Edison Company's, 51
Swift & Company's, 43
Wilson & Company's, 45

T

Tests, 150
 importance of, 78
paint, 76
paper, 132
Textiles, 150
Tires, 145
Ton, long and short, 187
Tote boxes, 278
Traveling storekeeper, 231
Tubes, copper, 171
Typical purchasing department, 15

W

Waste, checking, 88
 paper, 281
Wilson & Company's system, 45
Wire drawing, 168
Worker's viewpoint, 41

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